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CONSERVATION OF THE PURITY OF SOILS IN CEREAL CROPPING

THIS seems to be the day of "conservation." Having suddenly caught the idea that our natural resources are rapidly being wasted through careless methods, and largely because of the intense desire of our people to accumulate riches, many of the best minds are concentrating their efforts toward husbanding natural resources. With the rapid increase in population and the numerous new desires which go with civilization the drain upon natural resources becomes apparent to every one. Almost every magazine and daily paper bears a message upon some new phase of conservation: As the conservation of human health and energy, conservation of forests, mines and water power; and the essentials of soil fertility; and there are even those who are crying for the conservation of capital, perhaps not unwisely.

The greatest asset of the human race is the earth and its products, and it is a view of the necessity of conserving a certain feature of crop productivity of the soil that I wish to bring before you. While we all talk freely of conservation, it must be recognized that there is no feature of it that is easy to carry out in a theoretically correct manner. Human interests and human understandings are so diverse that what is fact to one man is theory to another. In dealing with so simple a matter as the cropping of the soil to a particular crop, it is only when a great majority of our best educated agriculturists agree upon a feature, that it seems possible to get it accepted by the farming public, and often then it is only a comparatively small

number that actually carry out the work in a manner sufficiently effective to demonstrate the worth of the method.

Every man of normal mind honestly wishes the welfare of his race, and his nation in particular. It is nevertheless apparent that great difficulties must of necessity beset any attempt on the part of the state or the nation to conserve any one of its natural resources; for after all has been said, conservation is a biological problem. It is essentially impossible for the individual to actually place the nation or society at large as first in importance as against the actual and apparent necessities of self and family. It is all the more difficult because it is hard, because of the lack of facts, for the individual man to clearly distinguish actual necessities of individual and family life from apparent necessities and the actually necessary steps in work from the useless. Thus the collective desires of society for conservation must always meet strong opposition from individuals and classes of individuals. Any attempts to solve any of the great problems of the conservation or handling of resources which are possible of rapid development and exploitation, as, for example, the productivity of the new lands, meet with the difficulties which bear down on the individual and often even arouse antagonisms which are social and political.

Every one seems willing to conserve anything save only that upon which his daily bread and immediate future to him seems most to rest. The needs of the individual and of the family are real and important. Those of society and the nation are more indistinctly real to the individual, though they are none the less real and eternally necessary to society.

The individual longs for health, but, when diseased with an infectious disease, is apt to rebel when placed under the restrictions of quarantine, for that, in part, lessens or curtails his hope of gaining an immediate livelihood for himself and family. The farmer places his available funds and labors into new lands, which to him represent his immediate source of supplies, and instinctively must exert every effort to exploit and develop those resources upon which he depends in what to him appears to be the most effective manner to serve his immediate wants. Thus arises the desire to crop rapidly and largely, if not well. This view of the case, considered calmly, is very apt to place each of us in a better attitude towards helping the individual farmer in his struggle with cropping conditions. It is easy to say, "Oh, the farmers are an ignorant lot." "They sow one crop continually on the same land." "They do not rotate." "They do not make proper use of available fertilizers, suitable for plant growth," etc., but there are few members of this congress who do not realize that the science of cropping is not yet a very definite one, and if it were, and we should expect each farmer to understand it for the five or six necessary crops to be grown on his land, that we are asking him to understand principles of far more delicate and scientific nature than could now be expected of the lawyer, doctor, banker or other professional man.

We must also realize that many theories of agriculture which are by us recognized as correct in principle quite often fail to give results in practise. It thus behooves us as investigators to search for details which will explain many of the contradictory results obtained in our general cropping methods. *That the methods of the individual farmer are quite generally opposed to the real needs of society, and are often greatly to his own disadvantage, I believe gives the real foundation for the true doctrines of soil conservation and*

makes it clear that the true and safe route for the conservation of the natural resources of the soil rests in proper enlightenment as to the nature of the resources concerned and of the nature of the first causes which tend to destroy or cause deterioration in them. It is better to educate in cleanliness of person and premises than to set up quarantine against infection. It is better through force of education, or if necessary through education by lawful procedure, to force or bring about the cleaning up of underbrush in the spring than to have to fight destructive forest fires in August, or to waste time scolding corporations who as individuals do not know a sick tree from a ripe one. *Prevention is the most effective force whether we think of controlling criminals or of amelioration of crops.* So it is that our province as educators, especially with reference to conservation of the cropping powers of the land, is to so go into detail of explanation and demonstration of the causes of improvement or deterioration in crops that the individual farmer shall be able to understand the processes which are really necessary for his welfare, showing each worker wherein his methods are really effective in satisfying his needs, and wherein detrimental, both to himself and to society. If our methods of conserving the crop-producing powers of the soil are to be accepted, we must show that the methods proposed meet the needs of the individual farmer as well as of posterity so clearly that he can not be confused. If we can do this each individual worker will at once become an enthusiastic soil conservationist. If we can not do this, we can not expect it. Even then greed may make social criminals of some whose work is dependent upon the farmer, but the number of such will lessen rapidly under the educational forces of properly constructed laws. Even though seed dealers know that poor qualities of diseased seed and seed of mixed variety are very destructive to the interests of the farmer, and hence directly destructive to their own interests, yet most so-called seedsmen handle seeds much as a lumber yard handles coal or wood. Then there is the elevator man whose whole business interests are wrapped up in the successes of the work of the cereal crop producers, who yet buys seed from several farmers, mixes and spoils the whole lot, then sells it back to a new lot of farmers, making good returns from each transaction. Knowing this, one can understand why it is difficult for an individual operator or a number of them in cooperation to appreciate the point that it would be to their direct interest to sell, if they are to sell seed at all, only seed of reasonably pure, unmixed type. In both of which cases a well-worded seed law properly administered should prove of great benefit to all concerned and effectively educational.

The unnecessary waste in the exploitation of our mines and the rapid despoilation of the forest resources has aroused the nation, the work on the forests especially, because trees are big and beautiful and noticeably necessary to the very life of our nation, and the damage done to society by their destruction is at once apparent. Further, those of us who know the great value of phosphates in the production of seed grain can hardly do less than lament the rapidity with which these beds of valuable material are being mined and shipped abroad at but a trifle of their real value to the nation. We deplore this sort of loss because readily observable, but the same sort of greed for temporary gain in association with ignorance is depleting many other natural resources, among which most notable and far reaching is the first rapid depletion of the cereal crop producing ca-

pacity of the virgin soils, *through unsanitary methods of handling the soil, the crop and the seed.* It may be a comparatively new thought, but as I see it, there is no one factor affecting cropping results to so great loss of national wealth as the disease factor in the soil, and no one feature of cereal agriculture is so poorly understood and so much neglected. It is becoming common to term the farmer, and especially those who are farming in a large way "soil robbers." This is perhaps all right if we wish to shock them so that they may take notice while we call their attention to methods by which, if they follow them they may better their results and escape unjust criticism. But not all such men are intentionally "soil robbers." I have had the opportunity of meeting many wheat raisers, cereal croppers, who to my knowledge have more or less constantly followed the best advice available in cropping methods, at times with success and at times with indifferent success. Many are ignorantly soil spoilers and "crop deteriorators." It is to this phase of crop deterioration by soil contamination rather than to chemical depletion that I wish to especially call attention.

I recommend both our trained agriculturists and the farmer to look for help from a careful consideration of soil sanitation or, if you will, from proper conservation of the purity of the soil. I consider it particularly important that this question should be brought before this congress, for this meeting is located at a point west of the center of the last great virgin soil areas of this country. And because, while I recognize the great good that is done by the advocates of the conservation of the chemical qualities of the soil and still remain a strong advocate of the importance of that feature, I feel that we have followed it so persistently as to lose sight of other features which have vitiated many of the conclusions which have been drawn. When soil fertility is removed by persistent or constant cropping there must be some means provided for a reasonable replacing of the same; and crop rotation, as such, has been proved to be a matter essential to cereal agriculture. I believe, however, that the emphasis as to the cause of the necessity of crop rotation has not always been placed wholly in the right place. We have paid too little attention to physical or mechanical texture of the soil and too slight attention to cultivation methods as such, and no attention whatever to the sanitary condition of the soil. We have continued to tell the farmer that he must rotate because his methods of cropping are removing the nitrogen, humus and other essential features of the soil, apparently forgetting, although we all know, that a rotation is only another way of getting more of these elements out of the ground. We all agree in recommending stock as essential, apparently forgetting, although we all know, that that too is a condensed manner of getting rid of the so-called fertility of the soil.

So, if it had not been for the biologist demonstrating that the experience of many farmers in replenishing soil nitrogen through the use of legumes is a fact of plant life possible of intelligent control, our theories of crop rotation would at this time be in a sorry plight indeed, so far as proving the worth of them from a chemical standpoint alone. However, this problem of the conservation of nitrogen is now a settled one so far as common knowledge is concerned, and even the question of the conservation of the phosphates may rest in nothing more than the problem of equitable distribution of the world's supply. These fertilizers are based on substances that can not well get away. Though fertilizer experiments are as old as agricul-

ture and have been for the last century most carefully and elaborately planned, the best that we can say for the use of artificial fertilizers is that, as agriculturists, we are agreed that if we know the chemical make up of a particular soil it is possible to considerably enhance the cereal crop. However, regardless of all the extensive experiments, I think you will agree with me that it is not possible to state a plan purely of the nature of soil fertilization that will hold with any regularity as to the results on the crop for any extended area of soil for any long period of years. This is saying that the fertilizer question itself largely remains an experiment in spite of our best effort and that each farmer must largely learn what to do for himself, which is expecting much.

It is evident from studying the best and most extensive of these various fertilizer experiments that aside from soil texture and aside from differences in climate and variation in atmospheric conditions during different seasons there have been other unknown causes which have largely vitiated conclusions which may be drawn. This is equally true as to conclusions which may be drawn from long lines of carefully planned crop rotation experiments. It is one of these constant interfering influences which I wish to bring to your consideration, namely, the introduction of parasitic organisms which persist in the soil and seed, eventually bringing about soil sickness, such as has been recognized for cotton, melons, potatoes and many garden vegetables, alfalfa, clover and for flax. After extended experience with cereal crops of North Dakota and a rather close observation of them in various parts of this country, and of Europe, and from carefully conducted experiments extending over a period of twenty years directed upon the soil and the crop, I am convinced that such parasitic interferences with crop productivity constitutes one of the chief causes of the deterioration in quality and of yields of wheat, oats, barley and flax. Further, I would affirm, recognizing as I do that it is possible to so crop the soil as to withdraw chemical elements necessary to a complete normal yield, that, in most cases, especially in the northwest, this has not been done with regard to cereal crops, and particularly is this true of practically the entire area for Minnesota and the Dakotas. I know that the chemists and agriculturists have reasoned, from field tests with fertilizers and from laboratory analyses upon soil and seed, that chemical depletion of the soil is the chief cause of such deterioration, but my experiments make it impossible for me to accept the conclusion. There are areas of North Dakota virgin soil, represented by our school lands which yet remain unplowed, surrounded by old wheat areas which have been cropped for a number of years. These virgin lands when broken do not now, as when the prairies were first broken, produce wheat of number one quality, but often wheat of even lower grade and quality than that of the old lands immediately adjacent.

I know that in farmers' institutes in the various cereal-producing states, many farmers have said something to the effect that there must be a "change in climate," complaining that they no longer are able to produce wheat of the quality once produced, although they now work the land much more carefully, having better machinery. Some of them practise essentially all of the doctrines of the experiment stations and farmers' institute workers, and yet reap only low-grade grain for their trouble. I know that these questions have usually been answered by saying, "You can not expect to continue reaping grain of high quality." "Your constant meth-

ods of cropping have deteriorated your soil." The questions usually run, "What has happened to the soil?" "You have lessened the nitrogen." "You have changed the humus condition," or "You have withdrawn too much phosphates or potash," etc., as the case may be. The question then arises, "What shall we do?" The answer: "Rotate." "Raise stock." "Plant corn." "Cultivate." "Clear your fields from weeds." "Select seed." Yet many able farmers who are doing all these things reap 12½ to 15 bushels of shrivelled wheat where once they took 25 bushels to 30 bushels of 60- to 62-pound stuff. Such men tend to lose faith in our doctrine of conservation of the fertility of the soil and our doctrines of the necessity for crop rotation. Often the best rotation gives the most shrivelled grain and then, we as educators have been utterly at a loss to explain the cause unless we could attribute it to smut or rust, drought, rain, sunscald, etc. Indeed there are many Red River Valley farmers who will agree with me that when climatic conditions and soil conditions and harvesting conditions have been most propitious for the development of the wheat crop, often the yield has been of the most inferior type of seed. Though the bushels of grain and the tons of straw may be somewhat larger, the quality is so inferior as to be no longer in the class for which the northwestern wheat regions were once noted.

I am glad, gentlemen of the congress, that I am not only able to call your attention to these facts, which I think you recognize as not overdrawn, but that I can name the causes so that any one of you who wishes to investigate can verify. Our older wheat soils are sick throughout or sick in large areas in exactly the same sense as certain cotton lands are sick with root-rots, in the same sense as certain melon lands produce root-rot and blight, in the same sense as old potato lands which produce rot and scab, and in the same sense as the Germans recognized, when they spoke of flax being a bad crop to raise because it produced "Bodenmuedigkeit," "flax-sick" conditions. I am now able to recognize such wheat-sick areas and map them as well as I could four or five years ago for the flax-wilt disease. This mapping of the sick areas can be done any time from the time the wheat plants first come out of the ground to the time the stubble is plowed in the fall. How many distinct parasitic organisms it takes to make a typical wheat-sick soil we can not yet affirm, but our experiments are sufficiently extensive for us to state that at least five such parasites are persistent internally in most seed wheat, parasites which enter the seed before it is mature and are carried over to the next generation, and which are also, when once introduced into the soil, persistent there for a number of years following the introduction, and which, according to variable weather conditions, methods of handling the soil, variation in the fertilization of the soil, etc., are able to do a greater or less amount of damage. They are so truly parasitic in structure that they persist in their destructive work in any type of soil and in any type of atmospheric conditions in which the wheat plant can really survive. They are so saprophytic in habits that they fruit freely on decaying roots and stubble, and thus are readily distributed from crop to crop and from field to field. They are so parasitic that through their connection with the seed their distribution is made easy from field to field and from country to country, and I have found few samples of durum wheat and few samples of hard wheats or soft wheats, winter wheats, ryes or barleys that one or all of these wheat-destroying

parasites may not be obtained from the seed. Our survey covers every county in North Dakota and extends into Alberta and the wheat fields of Manitoba, Minnesota, South Dakota, Washington and California and the winter wheat regions of Indiana, Kentucky, New York and the wheat regions of Ontario. The parasites have been found in seeds imported from Russia, Italy, France and Algiers, and have been taken from samples of straw and roots from almost every important wheat area of Minnesota or North Dakota. I am thus confident that I am not announcing a crop destruction feature of local nature.

It is beyond the possibilities of this paper to detail the various lines of experiments by which these conclusions have been made necessary, but I may state that the three most destructive parasites, taken in their order, are one or more species of *Helminthosporium*, one or more species of *Fusarium*, the type of fungus which produces wheat scab and flax-wilt, and one or more species of *Colletotrichum*. These are universal and effective on roots and leaves, stems and seed, and various species of *Macrosporium* and *Alternaria* are great blighters of seed and destructive both on the straw and on the grain, especially at germination time. Our experiments have gone so far that I may say that I can take any type of soil in North Dakota and Minnesota which will grow the hard spring wheats and from it raise either a typically diseased crop or plants of normal growth. The methods of doing this are too expensive for farm operations. They consist essentially in soil and seed sterilization, whether it is done by chemicals or by heat. We have conducted persistent cropping experiments for many different pure pedigreed strains of wheat upon twenty-seven separate fertilizer plots, the strains of seed for all plots being the same at the beginning of the experiment, after which each plot has raised its own seed. These fertilizer experiments demonstrate clearly that in the absence of knowledge of the presence of the diseases no one could draw any reliable conclusion as to what crop they might cause to develop in any particular year. They do, however, demonstrate that various types of fertilizers have more or less effect upon the development of the diseases and of the crop, and that the mechanical condition of the soil has much to do with the development of both crop and diseases, and that whenever there is a tendency to check the development of the disease in the straw there is a tendency to produce plump seed. For example, the addition of phosphates does not seem to do away with the actual presence of the parasites in the soil, but it does enable the straw to ripen plump seed. The proper conclusion is not that the soil is necessarily deficient of phosphates, but that, the soil being infested with parasitic fungi, the addition of more phosphates tends to harden the straw in the same sense that a harsh dry atmosphere, such as some of you people are interested in, and such as North Dakota has suffered intensely from during the past season, tends to harden the straw and make plump wheat, though it does not of necessity mean a large number of bushels. I have this season seen fields that were so diseased with these root parasites that, in association with the drought, the wheat did not grow high enough to reach the sickle bar, and yet there was plump wheat from such sick plants. Whenever such sick areas received a reasonable shower or the soil was so cultivated as to conserve the moisture, there was an increase of bushels and a decrease of quality, due to shrivelling of the grains. The fungi are so constituted that they appreciate a highly vegetative type of straw, and when there is

an overbalanced supply of nitrogen plus moisture, they readily destroy such straw and the grain is proportionally shrivelled. They penetrate such straws rapidly and reach the seed at blossoming time and it is cut off from the mother plant and can not mature, even though in the straw there is left much unorganized plant food. Just in proportion as the fungi are capable of penetrating the straw the seed is deteriorated. Straws will crinkle and fall down when attacked by these diseases in a manner very characteristic of crops on overfertile or over-worked soils, even though there is a deficiency of moisture and of soil fertility, while the same pedigree of seed will stand strong and sturdy upon soil of much richer character with reference to nitrogen and still produce plump seed in the absence of the fungi. These fungi are so common and persistent in their nature in the soils of the northwest that if any one of you will go out into the stubble of an ordinary field where the wheat grains were evenly distributed in the drill row and of proper thickness of planting, and if you find that a part of the plants stool well and a large percentage of them produce only single straws of more or less weakness and smallness of diameter, I can assure you that you will find the roots of those unstooled plants in a diseased condition, whether you pull them before heading or after the grain is cut (usually black-footed, creosote colored or gray to mouldy). Exceptions are so few as to prove the rule. These diseases are of such nature as to largely account for the off grades in grain, for I have found in wheat plants which are sufficiently affected for the parasites to reach the seed that the grain will be off color, and will be graded by the elevator men as bleached and blistered, "black-pointed," "white-bellied," etc., even though cured under canvas and having suffered from no moisture effects whatever, either before or immediately following harvest.

One, and perhaps two, of the most destructive of these parasites produce the effects known as black point in durum wheat, a disease which is very prominent and becoming much more common of late years than when the grain was first imported into this country. Durum wheats, because of their peculiarity of straw, are able to produce plump wheat and yet carry diseases inside to such extent that 15 to 25 per cent. of properly harvested and cured wheat will not germinate. These diseases, especially the *Fusarium* type, largely account for the low germination of durum wheats. This I have proven both by culture work and by infection. The *Fusarium* diseases and possibly alternarial diseases largely account for the so-called "piebald" wheat or "white-bellied" wheat. I have previously claimed that moisture after the formation or maturity of the berry was the chief cause of this trouble. Others, notably Professor Shutt, of Ontario, claim that the loss of humus and nitrogen, causing a fall in the proteid content of the berry, is the cause, but I find that with the presence of certain fungi and a certain amount of moisture the result is almost certain, while in the absence of the fungi and moisture there is no piebald wheat, regardless of the nitrogen content of the soil.

All of these types of diseased grain breed true, that is, a diseased grain will carry the diseases to the soil, and if the seed can germinate and the young wheat plant can survive to the extent of producing seed, and the weather conditions are just right for the growth of wheat, the disease will be manifested in the seed of the progeny, and will persist in the soil so as to attack the following crop of wheat.

There are other features of marked interest which explain many of the common observations of cereal cropping. I can note only a few of these which might amount to an explanation of difficulties met with in our efforts at crop betterment and of the benefits which accrue from those methods which are recognized.

Farmers have noticed that where fresh barnyard manures have been spread upon their soils preceding wheat, a comparatively small amount has resulted in what they have called over fertility. My observations and experiments show that this is not necessarily over fertility, but increased soil infection coming from the excess of fungi due to cultures developed in the old straw and manure made from bedding straw drawn from diseased fields. Such straw introduced on the newest land immediately results in the production of shrivelled grain and in general crop deterioration in following years. In the case of flax my own experiments have been many times confirmed by the farmers. If barnyard manures which have been made by stock fed or bedded with flax straw are used, the soil may be ruined for the growth of flax by one application, even though no flax has ever been grown there before. This applies equally to wheat, barley and oats, when bedding made from sick straw of such crops is used, though apparently not so markedly destructive because of the fibrous method of rooting of these cereals.

We have all observed and advocated that the best possible preparation of a soil for the production of either wheat or flax is that which comes from a properly cultivated corn field, which is not again plowed before the grain is seeded, but which receives only shallow or surface cultivation. We have all observed that the expected better yields do not always follow, and that instead of getting plump wheat or good flax there may be much wilt in the flax or the wheat may not produce the big yield of plump grains. This in cases of wheat is analogous with the results on new lands, previously cited. There are two reasons why we may not of necessity expect better results on the corn crop ground. If that be a small piece of ground surrounded by old wheat stubble lands, the drifting or blowing of the diseases from these lands throughout the season may readily keep the corn ground thoroughly infected, while the cultivation sets free a larger and more available food supply and the crop grows ranker and more succulent, only to be destroyed by its parasitic enemies. If the field be sufficiently large so as not to be thus injured by the surrounding areas, or if there are no surrounding areas, the labor on that new well-worked land may be largely lost by the use of infected seed taken from old lands.

It is a well-known fact that quack-grass (*Agropyron repens*) is the most destructive weed known to cereal agriculture. It has been a wonder to most farmers and many experimenters why wheat is able to make so little progress against this weed even after the greatest efforts are made to prepare the seed bed. Usually we have assumed that the heavy rooting capacity of the quack-grass allows it to rapidly take charge of the ground, exhaust the moisture and thus overcome the cereals seeded over the quack-grass area. Our late observations and cross inoculations convince us that the quack-grass has a great advantage over the cultivated wheat. Not uncommonly the roots of the quack-grass, and especially the heavy underground stocks, are thoroughly attacked by several of these wheat-destroying diseases which fruit freely upon the dead and dying underground masses of quack-grass. The young wheat plants placed over such a center of

diseased material can have little opportunity to develop, being immediately attacked by the diseases and placed in competition with a much more vigorous plant.

The power of such parasitic diseases and of such soil infection is illustrated in the case of numerous garden crops, such as potatoes with potato scab, and cabbage with root-rot, asters with yellows or blight, but it is far more destructive on the field crops which produce seed than upon such heavy rooting plants. The history of the flax crop and its apparent necessary relation to new lands well illustrates the point. Few people believe the flax crop possible of success in any other than approximately virgin soils. Only in the Netherlands under the most intensive farming has the flax crop remained a permanent one. In all other countries it is essentially a new land crop. One, two, three or four paying crops have been removed from new land and then the grower has ceased to handle the crop, whether or not he wished, as the yield no longer payed expenses on the work.

These should be interesting facts to western farmers who dislike to see one valuable crop in our rotation disappear, and especially to know that during the last ten years the center of flax seed production has moved over 200 miles to the west. Interesting not because it is coming your way but because it is going. Even the transitory tow mills can not keep up with the chase. Statistics prove that there is no exception to the rule so far as the growth of flax seed is concerned. It is difficult to compile statistics from those available to show these facts, for, during the past ten years, the actual output of seed has tended to increase in North Dakota as a whole. It is only when we visit a shipping point and notice the land areas from which crop is no longer taken and those from which the seed is now coming that we know the truth of the matter. While a particular shipping point may yet be sending out more flax seed than it did ten years ago, we find that the source of the seed is from new lands, and that the farmers are hauling it longer distances to the shipping point. However, many of the older points in the state well illustrate this feature when contrasted with the newer shipping stations. Thus, for example, in 1902 the eastern town of Buffalo shipped 1,326 tons, while in 1909 the shipment from the same elevators was 520 tons. The new town of Richardton shipped a few bushels of flax seed in 1905 and in 1909 was shipping 814 tons of seed. Leeds in 1902 handled 5,075 tons of flax seed from one of its two lines of railway elevators, while the same set of elevators in 1909 handled only 120 tons of seed in contrast with Beach, a new station opened up for flax seed shipment in 1905, which handled 11,210 tons of seed in 1909. Devils Lake, Larimore, Cummings, Wahpeton, Landon, all originally great shipping points for flax seed in the eastern part of North Dakota, show records of practically no tonnage in 1909, while small towns such as Page, Hope, Stephen, surrounded by new lands, show shipments in 1909 exceeding 1,000 tons each. This is but the story of the transient nature of the flax crop as it now stands. The story not of its disappearance by lost fertility, but through disease infection of the soil.

It is interesting to know that many farmers have verified our conclusions that this disappearance of the crop is essentially unnecessary. Proper seed selection and seed disinfection associated with crop rotation will place the yield of flax seed always upon a profitable basis, the yield being considerably greater than anything that could be originally obtained.

This brings me to the real point of my

paper, namely, that we have a problem of soil sanitation which is far greater in its bearings upon the world's food supply and upon the principles of cereal cropping than any of the most enthusiastic plant pathologists or any of the most able agronomists have ever anticipated. If I am right in the conclusions which I have here set forth, then we have a doctrine of hope for cereal agriculture rather than one of despair. I have outlined causes which account for many of the anomalies in the best conducted experiments in crop rotation and soil fertilization, and have indicated bearings and influences which are now more easily understood.

If into your schoolroom, with its many children, there should come a patient afflicted with infantile paralysis, or one with diphtheria, or one with small-pox, each of you would be thoroughly frightened. You may not have seen anything, but you have learned to believe the doctor when he says that the symptoms exhibited by these patients are characteristic of infectious troubles and you say to the health officer, "This building must be closed and disinfected." Why? Because you know, if you do not do so, that, however healthy and strong the children sent there may be, there will be some who suffer great misery; some that are marked for life, some that are paralyzed and not a few who die.

So it is with cereal cropping. Large areas of the world's wheat fields are not depleted chemically, but rather contaminated with many of the diseases that wheat is heir to, and a number of these diseases are transmissible in nearly related crops. In saying this I am placing before you an argument for crop rotation which any one of you can understand and such as any farmer can understand without the discouraging thought that he has, because of his ignorance, in a few short years, in some cases one, two or three, destroyed his land by the removal of chemical elements. We all believe in crop rotation. Here is one of the reasons why it succeeds and a clear explanation why a properly planned series may fail. We believe in the conserving of fertility of the soil by the application of manure, and herein we have a clear explanation of the reasons why the application of manures sometimes is thoroughly destructive, and why under certain conditions it need not be destructive, why it is, for instance, that the processes of composting and the use of liquid manures by old-time gardeners and farmers do not go out of existence, regardless of the theories of those who wish to sell the manure spreader.

I am not an enemy of the manure spreader. It is a great labor-saving device, but I wish to say that unless it is used more intelligently than has usually been advocated in the northwest it may be placed as one of the most destructive agents now in use in cereal cropping through weed seed and disease dissemination. The manure spreader would still be a useful instrument if proper types of manure were spread on the right crop. We are all believers that heavy weight seed is more effective in crop production than light weight seed of the same pedigree. That has been pretty hard for one who believes in pedigree to understand; for the small amount of food which a parent seed can give the young plant, in most cases, is merely a start in the world. Here is the real explanation of the fact.

Those of us who have been directly interested in the disinfection of cereal grains for planting purposes have long since become convinced that proper seed disinfection greatly enhances the crop yield, even though the seed be number one, hard in quality, and though there be no smut

spores present for which disinfection was originally brought out. In North Dakota I have found that on the basis of a twenty bushel yield, number one hard seed, free from smut, disinfected with formaldehyde, may be expected to give, when planted on the same soil on the same day, from one and a half to four bushels per acre more than the same wheat not disinfected. For years I could not explain this any more than to say, "It is possible that formaldehyde may act as a stimulant to the young plant, or that it is possible that it may destroy other fungi such as bacteria, yeasts and moulds, etc. I now know that the spores of these soil and root diseases may often be present on the exterior of such seed, and thus we have a clear explanation and reason why all seed should be disinfected every year, regardless of the presence or absence of smut.

As previously indicated, the idea of conserving the fertility of the soil seems to be as old as agriculture, but the study of the soils from the standpoint of the health of the cropping plant as viewed from physical and mechanical texture and its disease-bearing features, are matters which have had much too slight attention. Overlooking them, we have not been able to explain the conflicting results obtained by our best theories or methods of cropping. We have had our thoughts centered on the possible loss or depletion of fertility and upon the possible unbalancing of the food ratio as represented in eleven to fourteen chemical elements, and although we have known well that a plant can use up essentially every bit of an available plant food before deterioration becomes apparent in its growth qualities, we have blindly assumed that many soils which from their texture and age should be thoroughly fertile, are nevertheless depleted in their food supply. We have paid too little attention to the life of the plant itself and to biological features connected therewith, and to the needs of adapting our cultivation methods to the actual physiological processes of the plant that it may not sicken and become so weak as to fall an easy prey to its enemies.

Just at this point, I may say that these root diseases are of such nature, whether we speak of flax or wheat, that certain varieties and strains of the crops may be recognized as markedly resistant, and that even the common crop may resist to such extent as to produce a reasonable yield on a normal year. Yet through any untoward condition, such as the bites of insects, or injuries due to dry air coming in contact with the roots in a loosely prepared seed bed, or due to the weakening effects of poor drainage, the individual plants and the average of the crop may fall a ready prey to the disease-producing organisms. These organisms are not only parasites in their ability to attack young growing plants, but they are rather more saprophytes than parasites in the sense that whenever a plant tends to sicken and die they readily attack and overcome it, so that poor drainage and drought, heat, frost and insect depredations, greatly facilitate the destruction occasioned.

It is my belief that these soil and seed diseases, especially of wheat, flax and oats, have broken many a hope for a large crop, and have vitiated the conclusions drawn from many well-planned schemes of cropping.

What has this to do with the dry land farming? As previously indicated, there are great areas of this country that have been contaminated with cereal diseases. The methods of constant cropping, careless selection of seed, lack of seed disinfection, and the lack of proper preparation of the seed bed so as to properly firm it down and thus insure that the fine roots shall

always be in contact with sufficient moisture to allow them to make a normal, sturdy growth, have gone on in such a careless manner as to greatly reduce the wheat yields of all countries wherever such cropping has been practised upon a large scale such as is known in the new lands of the northwest. Where this contamination of soil has occurred the loss of the flax crop has been unavoidable, and profitable wheat raising has only been continued under intensified farming conditions. My belief is that we must yet be able to produce the bread of the world by the use of extensive machinery and upon extensive plans, such as is yet being carried on in the new lands of the west. I have set forth *the reasons why this can not be done unless we recognize this question of soil sanitation,* or, if you will, *the necessity of conserving the virgin purity of the land.* I am, however, confident that with the proper understanding of the methods which are now known for selecting seed, disinfecting seed, rotating crops and perfecting the seed bed there should be no necessity of growing wheat upon the costly lands now under intensified farming systems, and that there is no immediate necessity of abandoning the cropping to cereals on the large plan which is characteristic of the northwest. I believe firmly, however, if we do not thus recognize this matter of the necessity of soil sanitation, soil disinfection by means of proper cultivation, and well-planned series of crop rotation, that, no matter how fertile the soil of one of your western valleys may be, no distant year will see your crop fall very close to the world average for that particular cereal.

This message, if so it may be called, has also a direct bearing upon matters in which you are interested which I think you will thoroughly appreciate. Those of you who are directly interested in dry land farming may expect these diseases to be less effective under dry farming conditions than under the old-line cropping methods. For the dry farming methods and the dry atmospheric conditions are just such as tend to keep such cereal organisms in best control. If, however, you wilfully spread diseases upon your lands through infected seed and through infected fresh, uncomposted manures, if you wilfully neglect to rotate and if you fail to properly aerate and firm down the seed bed, you may expect these destructive cereal diseases to take their annual quota from your crop, and that the crop depletion will increase with the years. There seems to be no exception to the common observation that the living can not thrive in contact with the dead of the same species.

If, on the other hand, you declare for careful seed selection in all cases, careful seed disinfection at all times, the formation of a well-aerated but compacted seed bed, and for as extensive a rotation of crops of as wide-spread character as possible, you of the new dry land regions of the west have the greatest possible opportunity to prove to the world that it is not necessary to lose a crop of such importance as linseed from among your rotations, nor is it necessary that your wheat yields should fall from the now promising ones of thirty to sixty bushels per acre to the general average of twelve to fifteen.

H. L. BOLLEY
NORTH DAKOTA AGRICULTURAL COLLEGE,
September 20, 1910

THE FOURTH CONFERENCE OF THE INTERNATIONAL UNION FOR COOPERATION IN SOLAR RESEARCH

THE main party of delegates to the fourth Conference of the International Union for Cooperation in Solar Research arrived in Pasadena on August 28. On the following

morning the laboratory, shops and offices of the Mount Wilson Solar Observatory were inspected. In the afternoon the members and their friends were entertained at a garden party given by Mr. and Mrs. Hale at their home. On Tuesday the ascent of Mount Wilson was made, by some in carriages via the Mount Wilson Toll Road from Pasadena, by others on saddle animals from Sierra Madre. Including the staff of the Mount Wilson Observatory, the entire party making the ascent numbered about one hundred. Forty-two delegates from abroad, representing ten different nations, were present.

The sessions of the conference were held in the museum building of the observatory on the mornings of August 31, September 1 and September 2, with an afternoon session on the last day. The afternoons were for the most part given up to committee meetings and an inspection of the equipment of the observatory.

Professor Pickering occupied the chair at the session of the first day, Professors Campbell and Frost on the second and third days, respectively.

In his opening address Professor Hale considered the following salient points:

1. Emphasis of the union's function as a stimulator of research.

2. Benefits of formal cooperation as shown in the adoption of standards of wave-length.

3. Sun-spot spectrum map.

4. Description of the 150-foot tower telescope of the Solar Observatory and its equipment, when used for spectrographic observations and as a spectroheliograph.

5. The observation and interpretation of various groups of phenomena observed in sun-spots and in their spectra: sun-spot lines appearing as triplets or as quadruplets; lines asymmetrical in intensity or in separation; variations of intensity of magnetic field as shown in lines of the same and of different elements; apparent rotation of plane of polarization of the light by its passage through the spot vapors; methods of mapping the magnetic field in and around spots; unipolar, bipolar and multipolar vortices around spots.

6. Cooperative work—(*a*) with spectroheliographs, and the importance of the H_α line for this work; (*b*) in connection with eclipse expeditions.

The remainder of the first session was occupied by the presentation and discussion of the reports of the executive committee and of the committee on wave-lengths.

Professor Kayser presented the last-named report. The following recommendations were incorporated in it and were separately adopted by the conference:

1. In the region of the spectrum, in which three independent measurements by the interferometer method of the lines of the iron arc are available, *i. e.*, between λ4282 and λ6494, the arithmetical mean of the three measurements shall be adopted as definite international standards of second order, provided there is sufficient agreement between them.

2. The committee be given authority to publish these standards as soon as possible.

3. For the part of the spectrum in the neighborhood of λ5800, where the number and character of the iron lines is not satisfactory, the committee propose the use of barium lines as additional standards.

4. The laboratories or observatories possessing first-rate concave gratings are invited to determine by interpolation as soon as possible standards of the third order in the spectrum of the iron-arc within the above range of spectrum (*i. e.*, λ4282 to λ6494).

5. The measurement of standards of the second order shall be extended to shorter and longer wave-lengths, and the arithmetical mean of three independent determinations shall be adopted as secondary standards.

6. Standards of the third order shall then be obtained from them in the manner indicated.

7. The above system of standards shall be called the international system, the unit on which it is based being called the international unit (I. U.) as defined by the conference of 1907.

8. It is very desirable that in different laboratories possessing concave gratings of the first quality photographs of arc, spark and

solar spectrum and new measurements according to the international system shall be taken as soon as possible.

Professor Hartmann made the following suggestions, which were not accepted by the committee, but in accordance with his request are appended to the report of the committee:

1. In all cases, where owing to special reasons, wave-lengths are measured and published according to the "Rowland system," those wave-lengths shall be used as standards which are calculated from the recent interferometer measurements, taking as the wave-length of the red cadmium line λ6438.7098. (Such standards have been published by Hartmann in the *Physik. Zeitsch.*, vol. 10, p. 123, and others will be published in accordance with the best measurements.)

2. In order to avoid misunderstanding in the publication of wave-lengths, the system of standards used in each case shall be indicated by using special symbols after the wave-lengths. The following method is proposed:

(*a*) "M." "The Michelson System," based upon 6438.4722 M., as the wave-length of the red cadmium line.

(*b*) "C." "The International System," based upon 6438.4696 C., as the wave-length of the red cadmium line, the value adopted by the third International Conference.

(*c*) "R." "The Rowland System," as defined above.

At the second session the following reports were presented:

Measurement of Solar Radiation: Mr. ABBOT.
Sun-spot Spectra: Mr. FOWLER.
Eclipses: M. LE COMTE DE LA BAUME PLUVINEL.

Mr. Abbot discussed the measurement of solar radiation under the following headings: (1) Solar Constant Work by method of Langley, (2) Solar Variation, (3) Simplified Methods for Solar Constant Work, (4) Pyreheliometry, (5) Sky Radiation and Cloudiness, (6) Distribution of Radiation over the Sun's Disk, (7) Mount Whitney Station.

The committee on sun-spot spectra closed its report with the following resolutions, which were adopted by the conference:

1. That the report of the work of the sun-spot spectrum committee and of the cooperating observers, be printed in the next volumes of the *Transactions of the Solar Union*, in full or in abstract as circumstances may determine.

2. That notwithstanding the progress of photographic work, visual observations of spot spectra should be continued, and that the committee should be reappointed to continue the organization of this work.

3. That in view of our increased knowledge of spot spectra, the committee be authorized to prepare and circulate a revised and extended scheme of visual observations.

4. That in view of the fact that several observers have prepared manuscript catalogues of several thousands of lines in the photographic spectra of sun-spots, it is desirable to have such catalogues collated by those who made them, in such manner that all the available data should be collected in a single catalogue.

5. That it is desirable that, for the use of visual observers, the separate sections of the new photographic map of the sun-spot spectrum should not exceed 60 centimeters in length, and should be on a scale of 5 mm. to the Angstrom.

The eclipse committee, through its secretary, M. le Comte de la Baume Pluvinel, briefly recounted the experiences of the Flint Island expedition of 1908 and the Tasmanian expedition of 1910. The committee undertakes to further cooperation among eclipse observers by distributing observing programs to avoid duplication of work, and by aiding in the loaning of apparatus for eclipse observations. It was recommended by the committee that the direction of measurement of position angles around the sun's limb be from north to east. The recommendation was adopted by the conference.

Father Cirera presented the following report:

1. La communication de M. le Secretaire sur les eclipses a eté presenteé par moi à le Section d'Astronomie de l'Association Espagnole pour l'Avancement des Sciences. On

a decidé de cooperer avec l'Union solaire pour l'eclipse de 1912.

2. L'Observatoire de l'Ebro à Tortosa, peut fournir une copie photographique des éléments magnétiques, si l'on veut étudier le rapport des éclipses avec le magnétisme terrestre.

3. L'Observatoire de l'Ebro a tiré quelques photographies de l'éclipse partiel du soleil de Juin 1908. Il peut fournir des copies: le lieu et l'heure sont exactment connues pour faire des études astronomiques.

Professor Campbell explained a method that he has developed for obtaining a continuous photographic record of the change from the ordinary Fraunhofer spectrum into a bright line spectrum at the time of a solar eclipse.

At the third session reports were heard from the committees on solar rotation and on work with the spectroheliograph.

The solar rotation committee discussed the following topics:

1. The accurate determination of the angular velocity of rotation at various latitudes and the derivation of a formula representing with a high degree of precision the variation of velocity with latitude.

2. A definite conclusion as to the existence of secular or periodic variations in the sun's rate of rotation.

3. The investigation of the rate of rotation as shown by the lines of different elements and of the arc and enhanced lines of the same element, with a view to determining whether either the absolute rate of rotation or the law of variation with latitude differs for different substances.

4. The study of lines selected from different regions of the spectrum.

5. The detection of possible systematic proper motions or drifts in the sun's reversing layer.

The committee made the following recommendations to observers:

1. That the observers select at least to a partial extent different regions of the spectrum so that the total range of wave-length under observation may be as great as possible.

By general consent of those present at the meeting of the committee, the following regions of the spectrum were selected by the various observers:

λ3800–λ4000	Bélopolsky.
λ4000–λ4140	Schlesinger.
λ4300–λ4500	Newall.
λ4500–λ4700	Adams.
λ5100–λ5300	Adams.
λ5500–λ5700	Plaskett.
λ6250–λ6350	Dyson.

2. That within these regions the selection of lines be made with a view to the inclusion of a considerable number of elements, particularly such as are of very high or very low atomic weight, and also the enhanced and the arc lines of the same element.

3. That an agreement be made upon the latitudes to be observed.

After considerable discussion the committee decided to recommend the following points of heliographic latitude: 0°, 15°, 30°, 45°, 60°, 75°.

4. That an especial attempt be made to secure observations in the highest latitudes, particularly between 75° and 90°.

One or two of the observers present expressed their willingness to attempt determinations at latitudes 80° and 85°.

5. That a short list of selected lines be employed by all of the observers in common, the results to serve as a check upon instrumental or personal errors, and that a list of the points of latitude to be observed accompany this list.

The committee selected for this purpose the portion of the spectrum between λ4220 and λ4280, and the three points of latitude 0°, 30° and 60°. The secretary was authorized to choose a list of lines and forward it to the various observers for approval.

That an attempt be made to secure at least one independent series of observations in each of the solar hemispheres with a view to determining a possible difference in the rate of rotation.

Several observers expressed their willingness to undertake such observations of this character as the construction of their instruments would permit.

The resolutions reported by the spectroheliograph committee were as follows:

1. That daily photographs of the calcium flocculi be continued by the cooperating observatories.

2. That provision be made, if possible, for the measurement of the photographs.

3. That the desirability of providing for the daily photography of the hydrogen alpha flocculi be suggested to the cooperating observatories.

4. That the observatories at Tacubaya, Mexico, and Madrid, Spain, be added to the list of cooperating observatories and that their directors, Messrs. Valle and Iniguez, be invited to join this committee.

5. That the advantage of undertaking work with the spectroheliograph in Japan be suggested to the Japanese government.

6. That the desirability of utilizing large spectroheliographs of high dispersion for the study of the upper layers of the solar atmosphere is recognized by the committee.

7. The committee express the hope that the Secchi memorial fund now being raised in Italy may be devoted to a tower telescope equipped with a spectroheliograph.

At the fourth session the conference voted to extend the activities of the Solar Union so as to include general astrophysics. A committee was appointed to examine and report upon the question of the classification of stellar spectra.

The following resolution with regard to the proposed solar observatory in Japan was passed:

That this conference learns with satisfaction that the erection of a solar observatory in Japan is in contemplation and expresses the opinon that the establishment of such an observatory would fill a gap in the distribution of solar observatories over the surface of the earth, and would materially help in obtaining results of great value in the study of solar phenomena.

It was decided that the next meeting of the Solar Union be held in Bonn in 1913, the exact date to be determined later.

The following committees were appointed or reappointed:

The Committee on Standards of Wavelengths: H. Kayser (chairman), J. S. Ames, Ch. Fabry, A. A. Michelson, A. Perot.

The Committee on the Measurement of Solar Radiation: J. Violle (chairman), C. G. Abbot (secretary), H. L. Callendar, C. Chistoni, W. H. Julius, A. Schuster.

The Committee on Work with the Spectroheliograph: G. E. Hale (chairman), H. Deslandres, E. B. Frost, W. J. Lockyer, A. Riccò, Father Cirera, Philip Valle, Francisco Iniguez, P. Eversheim.

The Committee on the Investigation of the Spectra of Sun-spots: H. F. Newall (chairman), A. Fowler (secretary), A. Bélopolsky, The Astronomer Royal of England, Father Cortie, H. Deslandres, G. E. Hale, Sir N. Lockyer, P. Eversheim, A. Wolfer, Philip Fox, Walter Mitchell and Walter S. Adams.

The Committee for the Organization of Eclipse Observations: Sir Norman Lockyer (chairman), le Comte de la Baume Pluvinel (secretary), W. W. Campbell, Father Cirera, P. Kempf, H. H. Turner, A. Riccò, N. Donitch, Major E. H. Hills.

The Committee on the Determination of Solar Rotation by Means of the Displacement of Lines: N. C. Dunér (chairman), W. S. Adams, A. Bélopolsky, H. Deslandres, J. Halm, H. F. Newall, R. A. Sampson, F. W. Dyson, Frank Schlesinger, J. S. Plaskett, M. Perot.

Committee to Report upon the Question of the Classification of Stellar Spectra: W. S. Adams, W. W. Campbell, E. B. Frost, J. S. Ames, J. C. Kapteyn, H. F. Newall, E. C. Pickering (chairman), J. S. Plaskett, H. N. Russell, Frank Schlesinger, K. Schwarzschild, J. Hartmann, G. E. Hale.

On the evening of September 1 Mr. Abbot lectured on the measurement of the solar constant of radiation, while on the following evening Professor Kapteyn gave an account of his investigations of the systematic motions of the Orion stars.

The 60-inch reflector was placed at the dis-

posal of the visitors for three nights, during the first two of which excellent views were had of nebulæ, star clusters and planets at the 100-foot focus. On the third night the focal plane spectrograph was exhibited in operation at the 25-foot focus of the instrument.

The Snow telescope, the 60-foot tower telescope and the 150-foot tower telescope were observed in operation on the sun, as was also the equipment of the Astrophysical Station of the Smithsonian Institution.

The committee on magnitudes for the Carte du Ciel and the committee on selected areas took advantage of the presence of their respective members to hold meetings. The first-named body agreed on the following:

1. That the photographic magnitudes shall be perfectly independent of the visual ones.

2. The two scales, however, shall coincide for the stars of spectral type Ao of magnitude 5.5 to 6.5, Harvard system.

The several methods used at Harvard for obtaining fundamental magnitudes were explained and discussed. Further work on such fundamental photographic magnitudes is contemplated by the observatories of Harvard, Potsdam, Mount Wilson, Simeis and Johannesburg.

The committee on selected areas noted the progress of their work along the following lines: (1) Durchmusterung plates, (2) parallaxes, (3) proper motions, (4) additional proper motion plates for the parallels of $-45°$ and $+45°$, (5) visual and photographic standards of magnitude, (6) estimates of visual magnitudes, (7) the photographic magnitudes, (8) photographic magnitudes of the Cape Photographic Durchmusterung, (9) classification of spectra, (10) red sensitive plates, (11) radial velocities, (12) sun's motion through space, (13) brightness of the background of the sky, (14) selective absorption of light in space.

On Saturday, September 3, the descent from the mountain was made. That evening the members of the conference were entertained at dinner at the Maryland by Mr. and Mrs. Hale.

H. D. Babcock

SESSIONS OF THE INTERNATIONAL COMMISSIONS FOR TERRESTRIAL MAGNETISM, ATMOSPHERIC ELECTRICITY AND METEOROLOGY[1]

The Commission for Terrestrial Magnetism and Atmospheric Electricity met in Berlin, at the Royal Meteorological Institute, Professor Dr. G. Hellmann, director, on September 23, with about twenty members present, M. Rykatschew, president, and Ad. Smidt, secretary. The first business was the reading of a report of progress on the work laid down by the commission at Innsbruck three years ago. Prominent place was given in further reports to the intercomparison of standard magnetic instruments, by Dubinsky, Schmidt and Chree, including the observatories at Pavlovsk, Karsani, Katharinenburg, Irkutsk, Upsala, Rude Scov, Kew, Potsdam and Cheltenham. The European observatories, especially in Russia, agree closely together, while an unexpectedly large discrepancy was reported for Cheltenham, which was accompanied by an explanation. With the view of enlarging the network of observatories it was intimated that steps were being taken to found one or two new permanent magnetic stations in Norway, and one in Italy or Tunis. The establishment of the magnetic observatory at Pilar, Argentina, in connection with solar physics and ionization researches, was reported. This station is a few miles south of Cordoba, and it is proposed to make it an important institution for the work of the southern hemisphere. Professor Bigelow, recently of the U. S. Weather Bureau, has been appointed to this duty, and Dr. W. G. Davis, director of the Meteorological Office, expects to develop the equipment as rapidly as is practicable. Arrangements were discussed at Berlin to facilitate the exchange of magnetic curves on days of large disturbances. The best methods of publishing the routine magnetic data, in order to meet the demands of students interested in solar physics and atmospheric ionization, were considered, but as the subject is complex it was referred to a special committee, v. Everdingen, Chree, Schmidt, for further

[1] Berlin, September 23–29, 1910.

examination and report. The progress made by the Department of Terrestrial Magnetism of the Carnegie Institution, as shown by a special report, in securing magnetic observations in all parts of the earth, especially on the ocean areas, was very favorably commended by a special resolution, expressing the gratification of the commission in respect of this efficient service. There is a disposition to form as close a cooperative association as practicable for the development of the research into the laws of the distribution and secular variation of the earth's magnetic field. From personal discussion it seems evident that the opinion is growing that the diurnal, annual and secular variations are due to the moving charges of free electricity in the atmosphere, carried by the general and local circulations, while the spasmodic large disturbances depend upon the bombardment of ionic corpuscles from the sun, and the slow oscillations of two or three days' duration upon the movement of ions through the gaseous upper layers of the atmosphere, generally along the magnetic meridians.

On September 25 a visit was paid to the observatories at Potsdam and Seddin. The meteorological, magnetic, astrophysical and geodetic departments at Potsdam were carefully inspected, and the officials in charge gave every facility for examining the apparatus. A most comprehensive and thoroughly scientific policy prevails at Potsdam, as is well known, and this, together with the beautiful surroundings, made a most agreeable impression upon the commission. Seddin is a new magnetic observatory about ten miles southwest of Potsdam, and, being located in the state forest area, will have protection from intrusion in the future. The advance of electric currents towards the Potsdam site has been met by the Seddin observatory for the variation observations, while the absolute measures are still carried on at Potsdam, together with such other magnetic work as is found practical and convenient.

The International Meteorological Committee met on September 26 in the same place, about fifteen members being present. Professor Bigelow was invited to a seat with the committee. Dr. W. N. Shaw was the president and Dr. G. Hellmann the secretary. Reports to the number of twenty were laid before the committee for discussion, and some of the important decisions will be mentioned. It is proposed to issue an official list of addresses of individuals and institutions which will facilitate the exchange of scientific publications. Steps are being taken to minimize the discordant methods now prevailing in the publishing of the mean values of meteorological data by the different services. The proposition to extend synoptic charts to the equator was referred to the Deutsche Seewarte for action. An account was given of efforts made to secure prompt daily telegraph service from Spain and Portugal, which project has the favorable assistance of those governments. The proposition from M. Köppen to adopt a new absolute system of the units of measure, including a specially defined barometer column as the unit of length with 1,000 subdivisions, was not found practicable at present. To meet the requirements of the Solar Commission and of the Commission of the Mondial System, it was agreed that the réseau of stations already selected by the commissions should be substantially adopted, and that the directors of the several services throughout the world should forward promptly to Dr. W. N. Shaw, London, the monthly means of the prescribed data for publication by the Solar Commission within the current year. These data are at present to be limited to pressure, temperature, wind direction and velocity at about 150 stations distributed so that there shall be one for each square of ten degrees of the earth's surface. It may become practicable to considerably increase the number of stations. This international scheme differs from that of the U. S. Signal Service in the seventies, in that the data are limited to accurately reduced monthly mean values, which are to be used in connection with the problems in solar physics. The committee approved the plan of securing accurate data for new isothermal charts of the world, but did not think it proper to prescribe the rules of reduction, or the special years to be selected for the group from which normals are constructed, on account of the diversity

of local conditions, but urged that each report should fully explain the methods of reduction actually practised. Two changes were made in the European telegraphic daily code messages: (1) three spaces now used by the wet bulb readings were dropped; (2) their places were supplied by figures representing the barometric tendency, that is, the change in the barometric pressure in a three-hour interval. Further arrangements were made for a wireless service in the important mid-Atlantic region represented by the Azores, so that there shall be a transmission of messages from Porta del Garda and Flores through Horta, to Europe, the United States and Canada. Similarly, the service will be improved from Iceland, Greenland and the Hudson Bay and Straits districts. These North Atlantic data are found valuable in making the weather forecasts. Thanks were expressed to the Portuguese government, Chaves, Ryder and Stupart for these prospective improvements. It has not been found that ordinary wireless messages from vessels at sea are yet sufficiently developed and controlled to give the necessary long distance and regularity required for improving the forecast systems, but further experiments are approved, especially in attaching remote stations to regular line offices. A special report was made on the unusual and unnecessary diversity of maritime storm warning signals, now prevailing all over the world to the great confusion of navigators, and after much discussion it was agreed to adopt the cone and drum signals for *day* use, as proposed at the London meeting of 1909, but that the subject of lights for *night* signals be referred to the same committee for further investigation. Hergesell made an extended report on behalf of the Commission on Aeronautics for the exploration of the upper air by means of balloons and kites, showing a great extension of permanent observatories in the United States, Canada, Argentina, in several countries of Europe, India, Australia, Africa and many temporary explorations, the most important being in the tropics and in the Arctic regions. In the tropics the isothermal layer usually begins at 16,000 meters elevation, and in the polar zone at about 10,000 meters. Below this layer there is turbulent circulation of the atmosphere, with mixing convection currents, while the isothermal layer itself seems to be the region of solar insolation without convection of importance. A proposition to explore the radiation effects in the isothermal layer by means of spectrograms was favored in principle, but no action was taken. Similarly, polarization observations were encouraged without special official instructions. The commission on radiation was reorganized and among the members Bigelow represents Argentina and Kimball the United States. The standardization of pyrheliometers was strongly urged, but it was thought too early to designate a central office for that purpose. It was hoped that the experiments now in progress would be sufficiently advanced before another meeting of the international committee to permit it to take more specific action at that time. No action was taken regarding the definition of gradient signs, as this involved the fixing of the fundamental system of the axes of coordinates of reference, which was too large a subject for immediate consideration. The topics of snowfall, water equivalent, evaporation apparatus and the status of these problems in meteorology were discussed without arriving at any definite resolutions. The next meeting of the international committee will take place at Paris, 1913. An interesting excursion was made to the important aeronautical station at Lindenburg on September 30; Professor Dr. G. Hergesell most courteously entertained the committee at dinner on September 28.

I have been very much impressed at the Berlin meeting by the notable advances in scientific meteorology, especially by the efforts to study the circulation of the atmosphere, together with the radiation and solar physics problems, as represented by numerous commissions. In addition to improving the usual forecast and storm warning services, and the climatological data, systematic plans are now fully in operation to develop the hydrodynamics and thermodynamics of the atmospheres of the earth and of the sun, in connection with the phenomena of solar radiation

and its very numerous effects in the atmosphere of the earth. The expense of the necessary instruments and the theoretical complexity of the problems will limit these special researches to a comparatively few students, but every encouragement is extended to those who are able to work along these lines.

FRANK H. BIGELOW

BERLIN,
September 30, 1910

LECTURES ON PUBLIC HEALTH

A COURSE of lectures on public health problems and the prevention of disease will be given at Teachers College, Columbia University, on Mondays at 5 P.M. throughout the year. The lectures, which are open to the public, are to be given during the first half year as follows:

October 10—"The Development of Public Health Work," Dr. Hermann M. Biggs, Medical Officer of the Department of Health of the City of New York.

October 17—"Water Pollution and Water Purification," Dr. C. E. A. Winslow, Associate Professor of Biology, College of the City of New York; Curator of Public Health, American Museum of Natural History.

October 24—"Clean Streets as a Factor in Public Health" (to be announced later).

October 31—"The Collection and Disposal of Municipal Waste," George A. Soper, Ph.D., Metropolitan Sewerage Commission.

November 7—"Communicable Diseases, Diphtheria, Typhoid Fever, Scarlet Fever, etc.—Their Transmission," Dr. William Hallock Park, Director, Research Laboratories, New York City Health Department.

November 14—"Communicable Diseases—Their Prevention," Dr. William Hallock Park.

November 21—"Some Examples of the Control of Infectious Diseases," Dr. Simon Flexner, Director of the Rockefeller Institute.

November 28—"The City Milk Supply and its Control," Dr. Ernst Lederle, President and Commissioner, New York City Health Department.

December 5—"Flies and other Insects as Carriers of Disease" (to be announced later).

December 12—"Housing and Health," Mr. Lawrence Veiller, Secretary, National Housing Association.

December 19—"Tuberculosis: The General Problem; The Organized Campaign against the Disease," Dr. Livingston Farrand, Executive Secretary, National Association for the Study and Prevention of Tuberculosis.

January 9—"Tuberculosis as a Social Problem. Methods of Treatment," Dr. James Alexander Miller, Associate Professor, Clinical Medicine, College of Physicians and Surgeons.

January 16—"What the Teacher should know of the Tuberculosis Problem," Dr. S. Adolphus Knopf, Associate Director of Clinic of Pulmonary Diseases, Department of Health.

January 23—"What the Teacher could do toward the Solution of the Tuberculosis Problem," Dr. S. Adolphus Knopf.

LOWELL LECTURES

EIGHT courses of Lowell lectures are announced for the present season, of which five are in the sciences. These are as follows:

Eight lectures by Franz Boas, LL.D., professor of anthropology in Columbia University, on "Cultural Development and Race." (1) "Human Faculty and Race," (2, 3) "Hereditary Stability and Adaptation in Human Types," (4) "Human Faculty as a Result of Cultural Development," (5) "Relations between Type, Language and Culture," (6) "Unconscious and Rational Elements in the Mental Development of Mankind," (7) "Can the History of Civilization be considered as a Single Evolutionary Series?" (8) "Types of Thought in Primitive and in Advanced Society." On Wednesdays and Fridays at 8 P.M., beginning Wednesday, October 19.

Eight lectures by Edward Bradford Titchener, LL.D., Sage professor of psychology in the Graduate School of Cornell University, on "The Structure of Mind." (1) "The Problem," (2) "The Method," (3) "Sensation," (4) "Attention," (5) "Perception; the Problem of Meaning," (6) "Conscious Attitude," (7) "Memory and Imagination," (8) "Patterns of Consciousness." On Tuesdays and Thursdays at 5 P.M., beginning Tuesday, November 1.

Eight lectures by William Ernest Castle, professor of zoology in Harvard University, on "Heredity in Relation to Evolution and Animal Breeding." (1) "Biological Discov-

eries Leading to the Rediscovery of Mendel's Law," (2) "Mendel's Law of Heredity and the Mendelian Ratios," (3) "Evolution by Loss or Gain of Unit Characters or by Variations in their Potency," (4) "Mendelian Unit Characters and Selection," (5) "Blending Inheritance and its Relation to Mendelian Inheritance," (6) "Reciprocal Crosses and Fixed Hybrids; Sex-limited Inheritance," (7) "Effects of Inbreeding and Cross-breeding," (8) "Sex Determination and Sex Control." On Mondays and Thursdays at 8 P.M., beginning November 28.

Eight lectures by Sir John Murray, K.C.B., F.R.S., LL.D., etc., of the *Challenger* Expedition, on "The Ocean." On Mondays and Thursdays at 8 P.M., beginning Monday, February 6.

Dr. Svante Arrhenius, of Stockholm, Sweden, will give a course on "Cosmology." Detailed announcements concerning this course will be made later.

THE BIOLOGICAL BUILDING OF THE UNIVERSITY OF WISCONSIN

WORK on the new biological building has begun at Wisconsin University. The structure will occupy a space 42 by 240 feet square, will be built of Madison sandstone and will follow the general style of architecture of University Hall. It is to be four stories high with a basement and sub-basement.

A room for the study of hibernating animals is to be the most novel feature of the new structure. Little work on the hibernation of animals has been done by zoologists up to the present time and many interesting findings are anticipated when work begins in the new building. Conditions of temperature, moisture, light, etc., will be kept at a uniform point to insure the best possible environment for the animals while hibernating.

Both a vivarium and an aquarium will be installed in the basement where many land and water animals will be kept for purposes of instruction, study and research. In the six greenhouses, which are to be built adjoining the main building on the south, a number of very rare tropical plants will be kept. An effort to secure data concerning their peculiar characteristics is the object of their culture.

The greater part of the main floor will be taken up by the museum. Collections of both botanical and zoological specimens will be installed there. At the rear of the museum will be the entrance to the lecture auditorium. This will be arranged in amphitheater form around a central raised platform, and will seat 500 students. A small room on the main floor will be devoted to the study of the effect of different lights on plants. A special study of the effect of violet rays will be made.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will hold a scientific session in St. Louis, beginning Tuesday, November 8, 1910, at 10.30 A.M. The meeting will be held in the graduate lecture room, at the Missouri Botanical Garden.

DR. ARTHUR MICHAEL, who has had his private research laboratory at Tufts College for the past twenty-five years, has removed the laboratory and scientific library to Newton.

THE "prix de Léonide Spendiarow" was established by a Russian gentleman of distinction who deposited with the International Geological Congress the sum of four thousand rubles, the interest to be awarded at the triennial sessions of the congress "for the best work on geological questions designated by the congress." The award is made by an international committee and was first given to Karpinsky, director of the Geological Survey of Russia; next to Professor Brögger, of Christiania; then to Tschernyschew, the successor of Karpinsky. At the recent Stockholm meeting of the congress the prize was given to John M. Clarke, New York state geologist, for his work on the Devonian of New York and eastern North America.

DR. FRANK H. BIGELOW, recently of the U. S. Weather Bureau, has accepted an appointment under the Argentine government, and his address will be *Oficina Meteorologica Argentina, Buenos Aires,* beginning with December, 1910. He was elected member of the

International Commission on Terrestrial Magnetism and Atmospheric Electricity and member of the International Commission on Radiation in order to represent Argentina. He has been a member of the International Cloud Commission and the International Solar Commission since their organizations.

DR. HERMAN A. SPOEHR, assistant in chemistry at the University of Chicago, has been appointed a member of the staff of the department of botanical research of the Carnegie Institution of Washington. Dr. Spoehr is investigating certain problems in plant physiology which lend themselves to the application of chemical methods.

DR. F. GOWLAND HOPKINS, F.R.S., late natural science tutor at Emmanuel College, Cambridge, and formerly demonstrator in physiology at Guy's Hospital, has been admitted into a fellowship at Trinity College upon receiving the appointment of prælector in bio-chemistry.

MR. R. B. GREIG, of the North of Scotland College of Agriculture, has been appointed a member of the Australian Agricultural Commission.

AFTER several months spent among the Crow Indians of Montana, Dr. Robert H. Lowie, of the American Museum of Natural History, has been at work among the Hidatsa of the Fort Berthold Reservation, North Dakota.

GEORGE F. KAY, professor of petrology and economic geology, University of Iowa, spent the months of July and August examining coal claims in the Katalla field, Alaska. He was in the employ of the Forest Service of the Department of Agriculture.

DR. ARTHUR EDWIN HAYNES, professor of engineering mathematics at the University of Minnesota, has been granted leave of absence for one year. He has taught consecutively for thirty-five years, the past seventeen at Minnesota University.

THE council of the Institution of Civil Engineers has made the following awards for papers published in the proceedings: A Telford gold medal to Major W. W. Harts, U. S. Army (Nashville, Tenn.); a Watt gold medal to Mr. A. Trewby (London); a Crampton prize to Professor A. H. Gibson and Mr. A. Ryan (Manchester), and Telford premiums to Messrs. W. R. Baldwin-Wiseman (Southampton), O. W. Griffith (London), Dr. W. E. Lilley (Dublin), W. Corin (Sydney), J. A. Saner (Northwich), and F. O. Blackwell (New York); the Indian premium for 1910 to Mr. C. W. Lloyd-Jones (Secunderabad).

PROFESSOR JAMES R. ANGELL, of the University of Chicago, will give three lectures at the Union College in January and February. They will be known as the Ichabod Spencer lectureship series, and are supported by the endowment of $75,000 for the department of philosophy which was recently made by Mrs. Catherine Leavitt, of Washington, in memory of her father, Ichabod Spencer.

DR. EUGENE OBERHUMMER, professor of geography in the University of Vienna, will give a course of lectures next month at the Johns Hopkins University.

THE Harveian oration before the Royal College of Physicians of London was delivered by Dr. H. B. Donkin on October 18.

THE monument to Johann Mendel, who died in Braun in 1884, was unveiled there on October 1 in the presence of a number of representatives of foreign institutions.

DR. ERNST VON LEYDEN, for more than forty years professor in the University of Berlin and eminent for his contributions to pathology, has died at the age of seventy-eight years.

DR. JAKOB LUEROTH, professor of mathematics at Freiburg, has died at the age of sixty-six years.

AN official announcement is made by the State Department of information received from the Berlin embassy concerning the recent establishment of the "Amerika Institut" in Berlin. Professor Hugo Münsterberg, of Harvard University, exchange professor at Berlin for the current academic year, is the first director of the institution, which is founded and supported by American and German contributors with the object of furthering

the "cultured relations" between the United States and the German empire.

The second International Conference for the Study of Cancer was opened by M. Doumergue, minister of public instruction at Paris, in the Great Hall of the Medical Faculty at the Sorbonne on October 1.

The *British Medical Journal* states that the evening meetings of the Eugenics Education Society will be held at Denison House on October 19, when Mr. J. H. Koeppern will read a paper on "The Eugenic Value of Maternity Insurance"; and on November 16, when Dr. F. W. Mott, F.R.S., will read a paper on "Heredity and Insanity" (giving the results of a recent inquiry). On December 14 there will be a discussion on "The Biological Factor in Infant Mortality." Afternoon meetings will be held in the Caxton Hall, Westminster, on November 1, when a paper on "Woman's Progress in Relation to Eugenics" will be read by Dr. Murray Leslie; and on December 1, when Mr. Edgar Schuster will read a paper entitled "Methods and Results of the Galton Research Laboratory."

Dr. E. C. Pickering, director of the Harvard College Observatory, announces that a new star, whose approximate position is R. A. $16^h\ 31^m\ 4^s$ Dec. $-52°\ 10'.6$ (1875), was discovered by Mrs. Fleming, in the Constellation Va, on October 13, 1910. It appears on 21 photographs taken at Arequipa with the 8-inch Bache and 1-inch Cooke telescopes, between April 4, 1910, and August 3, 1910. The magnitude has been estimated as varying from 6.0 to 10.0 between these dates. The spectrum is quite faint but shows, on three plates, the bright lines, 5007, $H\beta$, 4670, $H\gamma$, $H\delta$, $H\epsilon$ and $H\zeta$, one of the plates showing also the bright line $H\eta$. Apparently this object had passed into a nebulous condition before its spectrum was photographed. The star does not appear on 44 photographs, taken between August 20, 1889, and March 19, 1910, although almost all of them show stars fainter than the twelfth magnitude, and two plates show stars as faint as the fifteenth magnitude. Of the sixteen new stars found during the last twenty-five years thirteen have been found at this observatory, one by Miss A. J. Cannon, two by Miss H. S. Leavitt from photographic charts and ten by Mrs. Fleming from the Draper Memorial photographs.

Since March of the present year, Mr. Roy C. Andrews, of the American Museum of Natural History, has been studying and collecting the Cetaceans taken at the whaling stations on the west coast of Japan. He has secured skeletons of whales according to the following list: finback more than 69 feet long, humpback 47 feet long, sperm 60 feet long, sulphurbottom 78 feet long and two kill whales 22 and 28 feet, respectively. In addition, he has procured a number of skeletons of several species of porpoises. These skeletons, four of which have already made the long journey to the museum, have been presented to the museum by the Oriental Whaling Company of Japan.

Among the recent gifts to the American Museum of Natural History are the Lender's collection of costumes of the Plains Indians, presented by Mr. J. Pierpont Morgan; a valuable collection of Navajo blankets, presented by Mrs. Russell Sage, and two specimens of the African elephant as well as two of the square-mouthed or white rhinoceros, collected and presented by Mr. Roosevelt.

The "Entomology" by Professor J. W. Folsom, of the University of Illinois, has appeared in a Japanese translation, made by Messrs. Miyake and Uchida, of Tokyo.

An arrangement has been made with the Cambridge University Press by which that institution will take charge of the publications of the University of Chicago Press in England. The Cambridge Press thus becomes agent for these books and journals in all parts of the British Empire outside the western hemisphere. This arrangement applies to all future publications and, subject to certain existing arrangements, also to books already published.

The General Electric Company of Schenectady, New York, has presented the University of Illinois with a recording steam meter, a de-

vice which has been in successful use as a means of determining the quantity of steam passing any pipe to which it may be attached. The gift was transmitted on behalf of the General Electric Company by its Sales Manager, Mr. F. G. Vaughen, to Professor Ernst J. Berg, in charge of the department of electrical engineering. This is the second significant gift that the General Electric Company has made the University of Illinois during the past year, the first consisting of a 100-kilowatt Curtis steam turbo-generator which now constitutes a part of the equipment of the department of electrical engineering.

AN association for the promotion of astronomy has been formed in India. It is to be known as the Astronomical Society of India, and has its headquarters at Calcutta.

UNIVERSITY AND EDUCATIONAL NEWS

IT is announced that Mr. John D. Rockefeller has recently offered to give to Western Reserve University for further endowment of its medical department, the sum of $250,000 provided $750,000 additional is raised. Toward this $1,000,000 fund, as was announced in May last, Mr. H. M. Hanna, of Cleveland, has given $250,000. The trustees of the university have indicated their intention to undertake to secure the $500,000 needed to complete the fund.

YALE UNIVERSITY is to receive the residue of the estate of Samuel H. Lyman on the death of the testator's brother, Joseph Lyman, with the exception of $25,000, which goes to the Children's Aid Society. A trust fund, to be known as the "Joseph Lyman Fund for the Aid of Deserving Students," is to be established. The value of the bequest is not known, but the estate is said to be large.

THE construction of the new zoological laboratory of the University of Pennsylvania was begun on September 16. It will be completely finished and furnished by next summer. The total cost will probably be between $250,000 and $300,000. As planned, it will be the largest building yet constructed for zoology.

THE Drapers' Company, which has already done so much for the Agricultural School of Cambridge University, has offered a sum of £22,000 towards the cost of erecting a new physiological laboratory on the Downing site, and a further sum of £1,000 for fittings. The proposed new laboratory for psychophysics, the cost of which has been collected by Dr. C. S. Myers, will, it is hoped, be erected in the close neighborhood of the proposed building for physiology.

THE new chemical and physiological laboratories for the University of Bristol are now complete. The formal opening will take place on November 15 by Lord Winterstoke, chancellor of the university.

SYLVESTER K. LOY, Ph.D. (Hopkins), is acting professor of chemistry at Symons College, Boston, Mass.

THOMAS A. LEWIS, Ph.D. (Hopkins), has been appointed professor of physiology at Richmond College, Va.

THE executive committee of the board of trustees of Cornell University has made the following appointments: Seymour S. Garrett, '04, and John A. Wheeler, '03, assistant professors of mechanics of engineering; F. W. Buck, '09, C. E. Townsend, '07, and C. W. Davis, '07, instructors in machine design; J. F. Stephens, instructor in electrical engineering; D. S. Cole, instructor in electrical engineering; H. McClure, instructor in mechanics of engineering; J. F. Brauner, Jr., '05, instructor in civil engineering; A. H. Forman, instructor in physics; R. D. Anthony, instructor in pomology; R. R. Birch, instructor in experimental pathology.

APPOINTMENTS at the University of Michigan are: Henry Allan Gleason, Ph.D., assistant professor of botany; Alvin C. Kraenzlein, formerly of the University of Pennsylvania, assistant professor of physical training; Walter Mann Mitchell, Ph.D., assistant professor of astronomy; Carl Leonard DeMuralt, formerly of New York City, professor of electrical engineering.

DISCUSSION AND CORRESPONDENCE

AN OPEN LETTER TO MR. CARNEGIE

THROUGH the institutions founded by your initiative and endowment, you recognize that the most valuable asset of society is the higher order of human quality. The Carnegie Institution seeks the exceptional man, and furnishes him exceptional opportunities for his chosen work. The Carnegie Foundation provides security for the devotees of the higher learning, so that their services may be more freely given to the interests of the higher living. You thus recognize that the most direct way to advance the cause of education is by advancing the status of the teaching profession. It is in the interests of the Carnegie Foundation for the Advancement of Teaching that this communication is addressed to you.

The benefits of the foundation took the estimable form of retiring allowances. The professor of an accredited institution acquired his right thereto through the same service that entitled him to his salary. His initiative, not subject to review, determined whether and when he shall avail himself thereof. The dignity and temper of the policy at once commanded respect and quieted apprehension. Participation in the foundation was made a privilege, not a charity. Lacking all centralization, our universities may well profit by the incentive of a disinterested institution, liberal-minded and of national scope. By the tentative exclusion of the state universities, such a career for the Carnegie Foundation was jeopardized. In response to friendly protest, and through your generosity, a change of policy prevailed. A situation that similarly involves a question of judgment is now impending.

An alternative between two equally honorable forms of retirement was provided: that on the basis of *age* relieved anxiety; that on the basis of *service* offered varied scope to opportunities too commonly forfeited in an exacting career. After but brief experience, the retention of one of the two stated benefits, and the more attractive, is held in the balance. The prospect of its being found wanting has aroused widespread concern, intensely felt though academically expressed.

It is hardly necessary to repeat or review the public and private comments upon the propriety and the wisdom of this momentous step. Editorials, resolutions of associated professors and letters to the press have questioned the ethical propriety, even the legal warrant of the repeal. It is sufficient to record that any one acquainted with the officers of the foundation will promptly concede that if, in their opinion, withdrawal from an obligation were involved, the step would not have been so much as considered. It is unfortunate that the administration has used the reservation of the right to change the rules as a warrant for the action. This is sure to be misunderstood; only its friends and friendly critics know that the foundation may be assumed to agree with them, that far higher considerations than those of authority are here pertinent. There is, however, another point of view: that of the institutions and the individuals concerned. They may properly consider that through a mistake of judgment, a real injustice has resulted. It is at once natural and creditable that the professional class, to whom the foundation is dedicated—but most regrettably unrepresented in its administration—should feel that their interests have been slighted. More extensively than can be summarized, the plans of worthy men have looked to the use of the "service" retirement as the cherished consummation of their careers. Their projects involved sacrifice, for the allowance was small; but it was deemed secure. At present confidence has been impaired, and the term *foundation* deprived of its pertinence. A plea for "the advancement of teaching" urges the commanding appeal of justice and wisdom, and argues for a reversal of judgment.

The policy of the action can not be discussed in detail. The reasons assigned, with the utmost concession to their pertinence, seem bare and inadequate: nothing more serious than that a larger number of men have retired for less worthy reasons than was anticipated. Why not equally anticipate that the chief

faults on both sides—of too ready retirement, and of enforced retirement—may be amended without sacrifice of fundamental interests? The remedy proposed throws out the child with the bath in too drastic fashion. Some regard the "service" retirement as a most valuable provision; others question its value or its practicability. Where opinions differ, autocratic decision is premature. The retention of the provision for cases of disability may be gratefully noted; though the suggestion that the professor worthy to retire on his merits is a "rare" individual, seems superfluous. The summary action does away with the *right* to retire. The professor may be so fortunate or so unfortunate as to be granted it.

Such is the issue at hand. Those with confidence in the important mission of the Carnegie Foundation, and in the wisdom of its guidance, are unwilling to believe that financial reasons of future retrenchment—as has been variously implied, but in no manner officially admitted—have determined this regrettable abandonment of an estimable policy. The individual and collective protests that have been presented to the authorities indicate two essential steps. The injured sense of justice may be allayed and confidence restored by a temporary, or even a long-term, if not a complete reinstatement of the "service" retirement; this is imperative. Meanwhile, additional experience will suggest measures whereby the advantages without the shortcomings of the original provision will be preserved. Justice and wisdom and a loyalty to high purpose are the three saving graces of public institutions. May they all prevail!

JOSEPH JASTROW
THE UNIVERSITY OF WISCONSIN,
October, 1910

MEN OF SCIENCE AND PRACTICAL LIFE

TO THE EDITOR OF SCIENCE: There is certainly at the present time a great opportunity for improvement in the relationship which exists between the scientist and men in practical life.

In looking over the catalogues of some of the larger educational institutions, it is not an infrequent occurrence to see announcements, in their various departments of research, that the laboratories and all their facilities are open to men possessing the requisite qualifications for carrying on their independent investigations, while it is seldom that any one is found availing himself of this privilege, this being especially true of the middle western institutions.

The principle involved in these announcements is, without doubt, correct, if put into practise, but the fault seems to lie in the fact that the advantages to be derived from this are not clear to the outsider, and the men in the educational institutions do not take it upon themselves to make it so and to advertise this one of the most important functions of the schools, which are turning out engineers, professional men and men taking up research in pure and applied sciences.

It is well recognized that the association of the student with men who are enthusiastic and who are doing research, either practical or scientific, is one of the greatest stimulants that he can have. Above all, he is more likely to acquire the power of original thought and of handling an original problem in a better way and with more ease, the greater the number of men with whom he has the pleasure of association. This is especially true in practical lines where there are a large number of engineering students.

Although men engaged in instructional work in many of the leading colleges are expected to and do carry on scientific research, for the greater part there is nothing of a practical nature undertaken either by themselves or men working under their direction. This should not be the case in those institutions where the student is looking toward his college education as a means to an end. He should have the opportunity for association with men who are carrying on research of direct practical application.

There are advantages to the instructor that may be considered as nearly if not quite equal to those obtained by the student. The men who are engaged in teaching scientific

and engineering subjects, while they may be conscientiously carrying on scientific research in their own line, are much more likely to become broad, efficient teachers if they come more frequently in contact, in a professional way, with men who are engaged in work outside of the institutions of learning.

It is also true that the advantages are not, by any means, all one-sided, as the man in practical life, who has a problem to solve or who is working on the solution of some problem, can very frequently obtain valuable information by consultation with some man who is working along the same line in an educational institution. He may also frequently find it possible for him to work with a scientist who is well acquainted with that particular line of work, to their mutual advantage.

What can be done has been shown in one way at the University of Kansas with her industrial fellowships. This particular case may be the best possible thing for this place but, on the other hand, might prove anything but a success if undertaken at some other institution or under some other man, who did not have the personality to carry it through. Each man will have to work out the plan best suited to himself and his locality.

R. C. Benner
University of Arizona

THE REFORM OF THE CALENDAR

To the Editor of Science: In the September 2 number of Science is a communication signed Charles E. Slocum, in which are conveyed some expressions of Moses B. Cotsworth which suggest a method for remedying the troublesome irregularities of our present-day calendar.

Our calendar, among other heritages from our more or less remote ancestors, is characterized by incongruities that make it fit awkwardly into present-day human activities, industrial, commercial and social; and has indeed become an anachronism. The suggestion of a reformation of the calendar appears to be very timely, and the method proposed is simple and feasible, the changes indicated apparently not involving any embarrassments nor confusion in the business and social world.

It is to be hoped that this suggestion will take the form of an active movement, and will be promoted before international councils.

The discussion of the calendar not unnaturally invites some reflections upon our "legal holidays," those wandering comets of our almanac, which not unfrequently drop upon us unawares, to the great disturbance of the business world.

It is not a small matter to have the complex machinery of the whole body of finance and commerce throughout the country brought to a sudden stop, with most of the functions of the federal government suspended, at irregular times and when most people are unaware of such an event. This also is in the nature of an anachronism, and out of harmony with the working of the vast elaboration of machinery of present-day activities.

This is, moreover, a growing evil, based upon a combination of sentiment and politics, and legislators seem disposed to add a new "legal holiday" to the growing list on small provocation, in commemoration of some conspicuous person or political event in the country's history, apparently without consideration of the effect upon the business world.

A simple remedy would seem to be available for this evil also.

There are, it may be said, four cardinal holidays in our calendar, that have so grown into our system by habit of thought as not to constitute a disturbing element in the current affairs of the people, as all are thoroughly familiar with the times of their recurrence. These are New Year's Day, Fourth of July, Thanksgiving Day and Christmas. Other than these we have fifty-two Sundays in the year, which together would seem to afford ample time for rest and recreation.

The suggestion of a remedy for the evil of irregular "legal holidays" is, that they shall all be made to fall on Sundays instead of on week days.

T. G. Dabney
Clarksdale, Miss.,
September 5, 1910

SCIENTIFIC BOOKS

The Dawn of the World, Myths and Weird Tales told by the Mewan Indians of California. By C. HART MERRIAM. Pp. 273. Cleveland, The Arthur H. Clark Company. 1910.

This work of a well-known American biologist resembles Jeremiah Curtin's "Creation Myths of Primitive America" in that it endeavors to acquaint the general public with a body of aboriginal American myths, further in the fact that the tribe selected for the purpose is Californian. Mr. Merriam's book, however, has not only a popular appeal, but is of distinct scientific value and as such is worthy of careful perusal and study on the part of those interested in American Indian mythology and ethnology. The greater part of the Californian mythologic material hitherto published (Hupa, Kato, Wishosk, Lassik, Shasta, Achomawi, Atsugewi, Yana, Wintun, Maidu) belongs to the smaller half of the state lying north of San Francisco Bay. Besides some material, mostly San Luiseño and Diegueño, from the extreme southern part of the state, practically nothing, if we except Dr. Kroeber's "Myths of South Central California," which are chiefly Yokuts, has been published specifically referring to the folk-lore of the Indians between San Francisco Bay and the Mexican border. "The Dawn of the World," as explained by its subtitle, is devoted to the tribes variously known as Miwok (Merriam's Mewuk) and Moquelumnan. These tribes, of whom hardly anything beyond fragmentary notes have been published, include the Miwok proper of the San Joaquin valley and the foot-hills of the Sierra Nevada to the east, the Coast Miwok just north of Golden Gate nearly to Russian River, and the small group of Clear Lake Miwok northeast of the Coast Miwok.

The body of the book consists of a set of over thirty myths in the ordinary sense of the word, called "ancient myths" by Mr. Merriam, and a series of beliefs or "present-day myths" respecting animals, ghosts and the sign of death, natural phenomena, witches, pigmies, giants and other fabulous beings; an introduction on the general characteristics of Miwok mythology prefaces these two parts. Many of the myths proper are very short and are evidently but fragments of what must originally have been fuller narratives. "During the few years that have passed since the tales were collected," says Mr. Merriam, "several of the tribes have become extinct." Hence even a fragmentary myth is of positive value and thanks are due Mr. Merriam for having rescued what in some cases would very soon have become irretrievably lost. Several points of interest come out when the main facts of Miwok mythology are considered in comparison with those of other Californian tribes. In the first place, the creation of the world from out of a watery waste, a myth that is characteristic of the Maidu, Wintun and Achomawi of northern California, is conspicuous by its absence here; the creation of man from feathers is characteristic of the tribe. Secondly, Coyote, who in most American Indian mythologies is, if not always entirely, yet generally to a considerable extent, looked upon as a "trickster," meddlesome and obscene, is among the Miwok a consistently benevolent being and is, somewhat vaguely, looked upon as the creator. The great rôle played in Miwok mythology by the falcon, to a less extent also the "condor," is further noteworthy; this feature is paralleled also in the mythology of the Yokuts, who live to the south of the Miwok. Not a few of the myths published by Mr. Merriam find ready analogues among other Californian tribes, some even outside of California. Such, to mention but a few, are the theft of fire, of which quite a number of versions are found in the book, the making of hands for man by the lizard, and the "bear and deer" story (pp. 103–112), a widely spread myth found also in the Columbia River region and among the Shoshone of the Great Basin. The second part of the book, the "present-day myths," contains much of ethnologic interest and many of the beliefs listed could be paralleled among other tribes. That it is necessary for a person before he dies to have his nose perforated (p. 218) is, for instance, a belief shared also by the Yana of northern California as well as by other tribes of the state.

The myths are told in a rather agreeable

style and seem to reproduce the spirit of the original as well as could be expected of narratives not based directly on Indian texts. The practise adopted by Mr. Merriam, as before him by Curtin, of speaking of the animal, or better, pre-animal, characters by their Indian names instead of by the English translations of these names is hardly to be commended. Nothing is gained thereby. The Indian names are not really proper nouns, but merely the ordinary words for the animals referred to, so that their use not only taxes the memory of the reader, but, to some extent, gives him a mistaken idea of the character of the mythology. Yet it would be mere carping to dwell on so small a matter. It is to be hoped that this contribution to California folk-lore will be followed by others from the pen of Mr. Merriam.

Edward Sapir

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The Simple Carbohydrates and the Glucosides. By E. Frankland Armstrong, D.Sc., Ph.D., Associate of the City and Guilds of London Institute. Pp. ix + 112. New York, Longmans, Green and Co. 1910.

This monograph, one of the series on Biochemistry, edited by R. H. Aders Plimmer and F. G. Hopkins, presents an up-to-date summary of the chemistry of the subject, particular emphasis being placed upon those carbohydrates which have a biochemical significance. It would be a matter of no little labor for a physiologist to acquire from the scattered literature a conception of the present status of the subject comparable in any degree with Dr. Armstrong's excellent review. As an illustration of the interesting incidental suggestions which have been introduced appropriately, the following paragraph may be quoted:

> From the biological point of view, the fact that glucose exists in solution not as a single substance but as an equilibrated mixture of stereoisomeric γ-oxidic forms, readily convertible into one another, is of fundamental and far-reaching importance. If one of the stereoismerides is preferably metabolized in the plant or animal, in the course of either synthetic or analytic processes, the possibility of controlling the equilibrium in the one or other direction, so as to increase or limit the supply of this form, places a very delicate directive mechanism at the disposal of the organism. This question is undoubtedly one which demands the close attention of physiologists (p. 20).

The recent views regarding the structure of sugars are introduced in a way that is logical rather than dogmatic, and without rehearsing all the details of the evidence bearing on the points involved. The mono- and disaccharides are considered at some length, glucose being selected as the typical sugar for discussion. There are further included chapters on The Relation between Configuration and Properties, Hydrolysis and Synthesis, and The Natural and Synthetic Glucosides. The attempt of the author to present the subject by a stimulating method has resulted in a commendable success. A useful bibliography of 17 pages is appended.

Lafayette B. Mendel

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Mineralogie de la France et de ses Colonies. Tome Quatrième, 1ᵉ partie. A. Lacroix. Librarie Polytechnique, Ch. Béranger, Editeur. Paris, Rue des Saints-Pères, 15. 1910.

The fourth and last volume of Lacroix's "Mineralogie de la France" is now being published, the first part having just appeared and the second, or final part, being promised before the year is out. The second part of the third volume, which appeared in 1909, was reviewed in Science, Vol. 32, No. 816, August 19. The present part starts in with the manganites and plumbites, braunite, hausmannite and minium. Under the psilomelane group, romanéchite is described as a distinct species with the formula $H_2(Mn, Ba)Mn_3O_8$ or $(Mn, Ba)O \cdot 3MnO_2 + H_2O$. It is near hollandite in composition, but differs from it in that hollandite is much richer in iron, and has all the H replaced by metals. Romanéchite forms compact or concretionary masses with fibrous structure. Psilomelane is described

under the formula $xRO \cdot yMnO_2 \cdot zH_2O$, of which the cobalt bearing variety, asbolite, has an important economic value as a cobalt ore. Rancieite is a calcium-bearing variety of psilomelane. Under anhydrous sulphates and chromates are descriptions of mascagnite, thenardite and metathenardite, which is the name given to a polymorphic form of Na_2SO_4 stable above 235° and differing in its crystalline and optical properties from thenardite. It was found at a secondary fumarole (temp. 500–590°) of Mt. Pelée and had evidently formed from fusion. There are then described glauberite, anhydrite, the barite group with many photographs and crystal drawings, the alunite group in which an occurrence of natroalunite from Martinique may be noted, lanarkite, brochantite and linarite. Caledonite and leadhillite are the two sulfates with carbonates. The list of hydrous sulphates is an extensive one and includes mirabilite, gypsum (nearly 50 pages) and most of the vitriols, namely, epsomite, goslarite, morenosite, melanterite, pisanite, boothite, bieberite and chalcanthite. Further alunogen, connellite, coquimbite, fibroferrite, aluminite with which felsöbanyite and paraluminite may be identical, being only aluminite in a somewhat altered condition. Apatélite $(Fe, Al)_2(OH)_4 \cdot SO_4 + H_2O$ is a definite mineral species, its composition as here given being deduced from a new analysis of original material, the results obtained differing very much from the original analysis.[1] The remaining sulphates described are copiapite, glockerite, polyhalite, kalinite, halotrichite, pickeringite, metavoltite, roemerite, botryogen and cyanotrichite. Of the molybdates and tungstates there are wulfenite, scheelite and the wolframite group composed of ferberite $FeWO_4$, wolframite $(Fe, Mn)WO_4$ and hübnerite $MnWO_4$, though Lacroix states that the analyses of ferberite show an excess of FeO. Molybdite from Corsica showed qualitatively the presence of iron and water. The aluminates, ferrites, chromites comprise the spinel group, the various members of which (spinel, hercynite, chromite, magnetite, etc.) are fully described and illustrated, and the orthorhombic chrysoberyl. Only three borates are given, hambergite and rhodizite from Madagascar and ulexite. Nadorite, $PbO \cdot SbOCl$, from Algiers and the probable occurrence of romeite, $CaSb_2O_4$, therewith, are the two antimonites which finish the volume. The descriptions of the different minerals are given as in the former volumes and the paragraphs on the occurrences and associations are very full and contain much interesting information. The volume is richly illustrated with photographs and with crystal drawings.

WALDEMAR T. SCHALLER

[1] The composition of this and several related minerals badly needs revision. From the data now at hand, apatélite, raimondite, cyprussite and possibly several others are probably identical (W. T. S.).

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VIII., No. 3, issued September 15, contains the following: "Some Peculiarities of the Proteolytic Activity of Papaïn," by Lafayette B. Mendel and Alice F. Blood. A detailed study of the behavior of papaïn with especial reference to the accelerating effect which HCN exerts upon its action. "The Erepsin of the Cabbage (*Brassica oleracea*)," by Alice F. Blood. A typical vegetable erepsin can be prepared from white cabbage. "A Method for Determination of Saccharine in Urine," by W. R. Bloor. Evaporated urine is acidified and extracted with benzol. Saccharine is determined colorimetrically in the benzol extract by transforming it into a colored substance, probably phenol-sulphonephthaleïn or sulphurein. This is effected by heating with phenol-sulphuric acid. "Estimation of Saccharine in Urine and Feces," by Alfred J. Wakeman. A modification of Bloor's method. "Manganese of the Tissues of Lower Animals," by H. C. Bradley. Data from numerous analyses indicate that manganese is a normal constituent of the fresh-water mussels of North America. "Some Lipase Reactions," by H. C. Bradley. Experiments performed with human pancreatic juice show that the hydrolysis of triolein is regularly increased by increased amount of lipase; that a given

amount of lipase can hydrolyze a definite amount of triolein, irrespective of the mass of the latter; that reversion occurs in only negligible amounts when water is present. It is suggested that lipase may not be an important factor in the synthesis and storage of fats in the cell. "Behavior of Molds toward the Stereo-isomers of Unsaturated Dibasic Acids," by Arthur W. Dox. Comparisons of growth of various molds in media containing fumaric, maleic, mesaconic, citraconic and itaconic acids.

NOTES ON METEOROLOGY AND CLIMATOLOGY

Owing to the fact that the horizontal component of falling snow is frequently greater than the vertical, the catchment of the true amount of snow falling at any place has always been a problem of great practical difficulty. The complex whirls and eddies set up by the wind over the ordinary precipitation gauge do not allow the proper amount of snow to fall into the cylinder. For this reason it has frequently been the practise to cut out a cylinder of snow from an open place where the snow lies at an average depth, and convert this into the water equivalent. The increased use of water for irrigation and power purposes in the western part of the United States has resulted in a demand for a more thorough knowledge of the proper manner of measuring rainfall. Some time ago the United States Weather Bureau appointed Professor F. H. Bigelow to supervise a study of the problem. The first report of progress in this investigation has just been published. It consists largely of a summary of the results obtained from a number of stations in thirteen western states, all of which were equipped with similar apparatus. It contains the conclusion, "that it is not proper to give further consideration to any plan of constructing a seasonal snow or rain gauge that depends upon a pipe having a small diameter, such as the usual Weather Bureau rain gauge, the ten-inch standpipe, and the numerous automatic devices fitted with similar pipes for the catchment. . . . We infer that all the stations of the Weather Bureau should be equipped with snow bins, and that the rain gauges should be placed inside, the open top being within a few inches of the floor of the bin." The bin giving the best results thus far consists of a five-foot cubical box, open at the top, with its floor five feet above the ground. It also has inside and outside louver screens which prevent the formation of eddies. This much of the problem having been solved, it is probable that the experiments will be continued with the hope of constructing a seasonal reservoir for remote places where access is only occasionally possible.

In the latest number of the *Monthly Weather Review*, the June number, Professor A. G. McAdie, section director of the United States Weather Bureau at San Francisco, calls attention to some interesting facts in connection with the snowfall at Summit, Cal., the elevation of which is 7,017 feet. A table is published showing the seasonal snowfall for the past forty years, constituting one of the longest periods of snowfall observations in the country. The average annual snowfall for this period is 422.6 inches (35.2 feet), and the maximum for any one winter being that of 1879–80, when it was 783 inches (65.3 feet). Using a similar table as a basis, Professor J. N. LeConte has drawn a curve to show the average rate of melting and the relation between this and travel possibilities. The actual curve of melting for any year may be compared with the mean curve, and if it falls below the mean for the most part, the season will probably be a dry one, and travel in the mountains will be possible at a much earlier date than during a year when the actual curve of melting rises above the mean.

The British Meteorological Office has just issued a volume called "The Trade Winds of the Atlantic Ocean," consisting of three contributions to the study of the northeast and southeast trade winds. As stated in the preface, five years ago Dr. W. N. Shaw called attention to "the analogy between the seasonal variation of the trade wind and that of the rainfall of the south of England," and "added

a number of other considerations that seemed to point to a connection between what may be called the main arterial circulation of the atmosphere as represented by the trade wind and the meteorological consequences of that circulation in other parts of the world." Guided by this suggestion, Commander M. W. C. Hepworth has endeavored to trace, in the first paper in the present volume, the effect of variations in the trade winds upon the temperature of the water in the North Atlantic. The second paper is a lengthy discussion by Mr. J. S. Dines of all the data for St. Helena which the Meteorological Office possesses, especial attention having been paid to the anemograph records. The third paper consists of a mathematical demonstration, by Mr. E. Gold, of the relation between the variation of wind velocity and barometric fluctuation, one of the few meteorological problems amenable to direct mathematical treatment. Here again application of the general theorem to the particular case of St. Helena has been made.

THE first number of the "Monthly Meteorological Report of the Australian Commonwealth" has recently been distributed. This publication will doubtless serve the same purpose in Australia that the *Monthly Weather Review* does in the United States. Under the direction of its meteorologist, Mr. H. A. Hunt, the Commonwealth Bureau of Meteorology has had a remarkable growth, and now ranks with the weather services of older countries. As an example of its work note should be made of its latest bulletin, "On the Possibility of Forecasting the Approximate Winter Rainfall for Northern Victoria," by Mr. E. T. Quayle, an assistant in the bureau. The author has found a close agreement between the winter rains of that country and the preceding monsoonal depressions. The practise of forecasting even the approximate rainfall of a coming season by a government service is not common. The same bureau has also published an average rainfall map of New South Wales, the first of a series, now in the course of preparation, which will include all the states.

THE relation between free air conditions and those prevailing at similar heights on mountains has received considerable attention in Europe within recent years. Berson found from a comparison of the temperatures observed in balloons with those obtained on the Brocken (3,740 feet) that the mountain was 0.9° C. colder than the free atmosphere. Hann deduced from mountain observations that the mean temperature gradient up to 10,000 feet is 5.7° to 5.8° per kilometer, whereas balloon ascents gave a mean of 4.9° to 5.0°, while kite ascents gave 4.7°. Accordingly, air in contact with a mountain 10,000 feet high will be 2° to 3° C. below that at the same height in the free atmosphere. Shaw and Dines found that the results obtained in twenty-eight kite ascents showed that the temperature on Ben Nevis (4,406 feet) was in all cases lower than that in the free atmosphere at the same height over the sea to the west of the mountain, the mean difference being 2.6° C. In comparing the simultaneous values observed on Zugspitze (9,728 feet) and those recorded at the same height in balloon ascents from Munich, 56 miles distant, Schmauss found a mean difference of 1.6° C. between the synchronous temperatures, and 1.1° C. between the temperature recorded in the free air and the mean temperature of the day at Zugspitze. The same investigator also deduced, from a comparison of the temperatures on Zugspitze and Sonnblick, that the latter was 0.6° C. colder than the former at the same height, indicating that a mountain in the middle of a mountainous district is colder than one on the edge of such a district, and offering further evidence that the atmosphere is cooled by the mountain. Shortly before he went to Reno, Nevada, where he is now observer at the University of Nevada, Mr. S. P. Fergusson completed an investigation of this nature which had been carried on in the White Mountains of New Hampshire. Simultaneous observations at similar heights were obtained by means of kites in the free air, and recording instruments in a standard shelter upon the summit of Mount Washington. A brief summary of the results found

was published in *Appalachia* for 1910, but a more complete report will be given in a forthcoming volume of the "Smithsonian Miscellaneous Collections," part of the expense of the work having been provided for by a grant from the Hodgkins Fund.

At the recent Harvard-Boston Aviation Meet Professor R. W. Willson established what is likely to become a standard method for determining the maximum height reached by an aeroplane in flight. A thermograph, which had been used at Blue Hill Observatory for obtaining the temperature encountered by a sounding balloon, and a water barometer were attached to the aeroplane. The atmospheric pressure prevailing at the highest point reached by the aviator was later corrected for the temperature recorded by the thermograph, and the actual height computed with the aid of the usual tables. As a check upon this height, simultaneous observations of angular altitude were made by means of transit instruments, one at each end of a measured base line, and the height computed from the triangle thus obtained. As the method gives two independent determinations of height, the desired accuracy is attained.

In an article in "*Umschau*" by Dr. Karl Stoeckel, attention is called to the fact that ultra-violet light, like the rays of radium, decompose water into hydrogen and hydrogen dioxide, without evolution of oxygen. It is believed that the ultra-violet rays of sunlight which fall upon the water vapor suspended in the lower strata of the earth's atmosphere decomposes a small part of it to produce hydrogen, which rises to great heights, and hydrogen dioxide, which has been found in small quantities in rain-water. From spectroscopic observations of high, luminous meteors, Professor Pickering has shown that hydrogen is undoubtedly present. Moreover, Professor J. Hann has calculated that 99.5 per cent. by volume of the atmosphere at a height of 62 miles is hydrogen. A slightly larger proportion, 99.84 per cent., is obtained by Dr. W. I. Humphreys, of the United States Weather Bureau, in a recent research. It is not improbable that these facts will help to solve the problem of the upper inversion, as well as that of the slow desiccation of the earth.

Andrew H. Palmer
Blue Hill Observatory,
Hyde Park, Mass.,
September 28, 1910

PUBLICATIONS ON THE INDIANS OF THE NORTHERN PLAINS

For several years the department of anthropology of the American Museum of Natural History has been engaged with a cultural survey of the Indian tribes occupying the northern plains: viz., the Sarcee, Northern Shoshone, Blackfoot, Crow, Gros Ventre, Assiniboine, Hidatsa, Mandan, Dakota, Plains Cree and Plains Ojibway. Though far from complete practically all of these tribes have been visited and systematic continuous investigation inaugurated for the next five or more years as the case may demand. The formulated results are now appearing in the "Anthropological Papers" of the American Museum of Natural History, seven papers having been issued to date, four of which were previously reviewed in Science, October 16, 1908. The three to be discussed here are: The Northern Shoshone, Vol. 2, Pt. 2, pp. 165–306, Plate I. and 20 text figures, January, 1909, and The Assiniboine, Vol. 4, Pt. 1, pp. 1–270, Plates I.–III., and 17 text figures, November, 1909, both by Robert H. Lowie; The Material Culture of the Blackfoot Indians, by Clark Wissler, pp. 1–176, Plates I.–VIII., and 103 text figures, March, 1910.

The Northern Shoshone.—In 1906 Dr. Robert H. Lowie began an investigation of the northern Shoshone, or Snake Indians. His results, as published, show that in economic life these Indians manifest predominatingly the traits of the plateau area west of the Great Divide, especially in the use of seed-grains and fish, the buffalo being little more than an incident in whose pursuit they made occasional journeys into the Missouri basin, a practise no doubt greatly stimulated by the acquisition of horses. In costume,

however, the northern Shoshone, like many of their southern relatives, bear a general resemblance to the plains type, but in the former use of the woven rabbit-skin robe and the exceptional use of the buffalo robe we have again plateau traits. The manufacture of coiled and twined basketry further differentiates them from the northern plains Indians, as do the absence of the elaborate medicine bundle, the sun dance and the men's societies. Decorative art seems, however, to have been strongly influenced by the northern plains; but while this influence is also evident in mythology, the predominating characteristics are those of the plateaus and California. Thus, on the whole, it appears that the older theory that the northern Shoshone formerly lived on the Missouri has no support, other than the traditions of battles among the Blackfoot, Crow, etc., all of which are probably based upon chance encounters with Shoshone hunting parties.

The Assiniboine.—Dr. Lowie also made a special study of the mythology and culture of two divisions of the Assiniboine, those at Morley, Alberta (1907), and those at Fort Belknap, Montana (1908). One of the important problems, here, arises from the assumed late separation of the Assiniboine from the Dakota and their subsequent association with the Cree between whom an important exchange of cultural traits must have occurred. Enough linguistic data were secured to show a distinct dialectic difference between these two divisions of the Assiniboine, suggesting that their separation from the Dakota must have been earlier than is really assumed. However, further investigation of the speech current among the various bands of Assiniboine now living in Saskatchewan will be necessary to a satisfactory conclusion. In mythology we again find evidence for the remoteness of the separation from the Dakota in so far that the Assiniboine show far less of the elementary Siouan characteristics than of the Algonkin. Among the close neighbors of the Assiniboine, toward whose mythologies are shown almost equally marked relationships, are the Ojibway, Cree, Blackfoot and Gros Ventre, all highly individualized Algonkin tribes. Ceremonial organization is another aspect of culture, receiving special attention in this paper, one of the most striking points being that the Assiniboine have a number of ceremonial societies in which there is no conception of anything like a series or age gradation, but in which, nevertheless are shown certain other analogies in procedure and regalia to these widely distributed plains features. This result led the author to a special examination of the various tribal associations so far reported to determine in how far the age classification series holds for the area at large. His conclusion is that neither the age relationship nor any other conception can be taken as the controlling principle, but that each tribe has in a way constructed its societies by "the novel synthesis of singly wide-spread elements" and not by the complete adoption of any one organization. This is, of course, largely theoretical and in opposition to the sociological theories of Shurtz and Webster, but in line with the synthetic structure of the sun dance, pipe ceremonies, beaver ceremonies, etc., of the same area noted by American anthropologists. In addition to these major considerations the paper contains data on material culture, art, social organization and religion.

The Blackfoot.—In 1906 Dr. Wissler visited the Blackfoot Indians in Montana, giving special attention to their material culture, the subject of the latest publication in this series. In this paper fairly complete data are presented under the heads of food and its preparation, manufactures, transportation, shelter, dress and weapons. Taking these aspects of culture alone, the Blackfoot manifest no important traits not shared in almost equal measure by some of their immediate neighbors, so that it is impossible to credit them with tribal individuality or to determine their relative weight as a factor in the development of plains material culture. A critical examination of available historical data shows that there is no firm foundation for the current theory that the Blackfoot migrated to the plains from the forests of the

Mackenzie basin within two and a half centuries, the presumption being that they have occupied the plains for a long period, whence their want of individuality can not be explained as due to disorganization attendant to the hasty assimilation of a new culture. Sufficient comparative data have been introduced under the various headings to show the relative position of the Blackfoot in the northern plains group and, in turn, the relative position of this group in the area at large. It appears that the material culture of the northern plains tribes was relatively least influenced by the tribes of the plateaus on the west, but profoundly affected by acquisitions from the south and the east. Thus, while tradition gives the Blackfoot and Assiniboine women of former times a costume like that of the Cree and Salteaux, within the historical period they have used the well-known form of the Kiowa, Ute, Arapaho and Dakota: again, the tipi of the Blackfoot, like that of the Crow, is of the type known to some Déné tribes and also the Salteaux, in contrast with the type used by the Arapaho, Dakota, *et al.* Throughout the paper a number of problems in the distribution of cultural traits have been defined for which additional data are needed, especially from the Cree and Central Algonkin tribes.

In closing, it seems in order to state that field-work among the Cree, Salteaux, Crow, Hidatsa, Mandan and Dakota has been sufficiently advanced to announce papers upon these tribes as the next issues of the series.

Clark Wissler

THE DISCOVERY OF FOSSIL MAMMALS IN CUBA AND THEIR GREAT GEOGRAPHICAL IMPORTANCE

From the standpoint of geographical evolution there was no more important announcement at the meeting of the Geological Congress at Stockholm than that of the discovery of a large mammalian fauna in the Pleistocene caves of central Cuba, by Professor de la Torre, of the University of Havana. Hitherto the known mammals of Cuba consisted of four living and one extinct species of rodents, and one species of edentates, according to America's great naturalist, the late Professor E. D. Cope (whose conclusions were necessarily adopted by the writer as long ago as 1894). Messrs. Vaughan and Hayes, although not workers in vertebrate paleontology, in writing of Cuba discredited the occurrence of even these few fossils, as reported by other observers, and, furthermore, reported as wanting, any Jurassic formation in Cuba, although such had been found at an earlier date.

Professor de la Torre's collection embraces a large Pleistocene fauna of rodents, edentates and other vertebrates, as also excellent specimens of Jurassic fossils. Some of these were exhibited at Stockholm and others are at present at the American Museum of Natural History, New York. These Pleistocene mammals, or other immediate ancestors, must have reached the island of Cuba by land tongues, now submerged to 6,000 feet, except those by way of Florida (of which Cuba is the extension of the continental mass), which are now only 2,100 feet below sea-level. These submerged land tongues are themselves incised by cañons, which were once land features, and show the recent submergence of the whole Antillean region, which hypothesis was also accepted by Cope. The migrations of these animals confirms a late great continental elevation, which can not be ignored in any theory relating to the origin of the glacial period. From the biological point of view, these fossil remains are of extraordinary value, and Professor de la Torre is to be congratulated on his remarkable discovery.

Apropos, it may be stated that the writer has also himself obtained from a cavern near the boundary line, on the French and Dutch Island of St. Martin, the remains of *Amblyrhiza,* a Pleistocene rodent as large as a deer; notice of which has not hitherto been published. This rodent reached the northeastern Antilles from South America (Cope) by land tongues between the islands, now submerged, in one case to 4,000 feet.

The physiographic evidence of a similar late great elevation of Europe, based upon now submerged cañons, has also been shown by

Professor Edward Hull, of England, and Dr. Fridjof Nansen, of Norway.

J. W. SPENCER

STOCKHOLM,
August 24, 1910

SPECIAL ARTICLES

THE PERMEABILITY AND CYTOLYSIS OF EGGS

THE question as to whether cells may change in their permeability to various substances and the bearing of these changes on vital phenomena, in particular the development of the egg, has excited much discussion of late. My own experiments (at Tortugas and Woods Hole) have been directed toward determining the permeability of sea-urchin's eggs for some one substance and the effect of certain substances in altering the permeability of the egg for this substance. Sodium hydrate was chosen for the purpose because its entrance may readily be indicated after staining the cells in neutral red. This dye, red in neutral and acid solution, becomes yellow in alkaline solution.

Since the classic researches of Pfeffer it has been well known that plant cells will take up and concentrate in their sap vacuoles, certain dyes, notably methylene blue, from very dilute solutions. In some cells the dye is precipitated as fine blue granules which Pfeffer proved to be a compound formed with tannic acid. In the leaf cells of *Elodea* the dye remains in solution yet becomes more concentrated than without. This gives the appearance of a diffusion of the dye into the cell against a concentration gradient, which is of course an impossibility. The dye must be changed within, but "the precise character of the still soluble combination in which pigment accumulates in the cell sap of *Trianea, Lemna, Elodea,* etc., is as yet unknown."[1] A clue as to the nature of the condition in which the dye exists in the cell is obtained by staining with neutral red. In tap water a dilute solution is brick red, indicating that a small amount of the dye is present in the alkaline yellow condition, the undissociated molecule (ROH), on the theory of indicators. But in the *Elodea* cells it is always bright red in color. This suggested that within the cells the neutral red existed in the acid or dissociated (RCl) condition which was unable to pass out. That this view is correct can be easily shown by placing *Elodea* leaves in tap water containing neutral red plus just enough acid to convert all the dye into the acid condition without injuring the cells themselves. Not a cell stains. Thus the protoplasts "select" only the undissociated molecules of basic dyes from a solution. Within the cell these are practically completely dissociated and unable to pass out, giving the appearance of diffusion against a concentration gradient. Exactly the same conditions hold for methylene blue, only there is no difference in the color of the dissociated and undissociated elements.

Sea-urchin eggs are also capable of concentrating neutral red from very dilute solutions, but the manner of retaining the dye is very different, although the conditions of entrance are the same. No neutral red can enter sea-urchin eggs from dilute acid sea water in concentrations which do not coagulate the egg. As soon as the eggs do coagulate they stain but in a different manner from the normal eggs. In the latter the dye is taken up (combined?) by granules distinguishable from the yolk granules, in that they always pass to the distal pole of the egg on centrifuging, whether first stained and then centrifuged or first centrifuged and then stained. They are present in the fertilized as well as the unfertilized egg (*Toxopneustes*), but the rate of staining of these granules is much more rapid in the former than the latter. I would attribute this to the rate of entrance of the dye and can therefore confirm for neutral red what Lyon has recently found for methylene blue.

If red-stained sea-urchin eggs are placed in hyperalkaline (100 c.c. sea water + 1.3 c.c. *n*/10 NaOH) sea water they retain their red color for several hours. When killed by chloroform-saturated sea water, the alkali almost instantly enters and turns the red to yellow. It may be shown that the color change is independent of the swelling of the egg caused by chloroform, for the penetration

[1] Pfeffer's "Plant Physiology," Vol. I., p. 94, 1900.

of alkali takes place just the same when swelling is prevented (for a short time) by the addition of cane sugar to the sea water. Either the NaOH fails to enter normal eggs or only enters so slowly that it is neutralized within the egg. Since the number of eggs is very small compared with the bulk of alkaline solution, and the alkali would continue to diffuse in, so long as neutralized, it would require an enormous production of acid on the part of the egg to take care of the NaOH entering. For this reason the first alternative seems more probable.

By treating eggs stained in neutral red with stronger and stronger concentrations of NaOH in 0.6 *m* NaCl the alkali penetrates more and more rapidly. If a concentration of NaOH which enters the egg in twenty minutes be one quarter saturated with chloroform, the NaOH enters in ten minutes. One quarter saturated chloroform in NaCl has no visible effect on the eggs even after one hour. The effect of dilute solutions of chloroform, which *fail to cytolyze,* on the eggs of *Hipponoë,* is to increase their permeability to NaOH. Indeed it may be shown in the same way, that small concentrations of chloroform increase the permeability of the leaf cells of *Elodea,* showing active protoplasmic rotation, and that the normal impermeability is again regained when the leaves are returned to tap water. The above statements are equally true for ether. It is obvious that the number of substances whose effect on the cell surface we may test in this way is limited, for most of them combine with NaOH.

Thus one of the most effective substances for producing artificial membranes, chloroform, increases the permeability of the egg for alkali. By comparing the time it takes for the stained eggs, fertilized and unfertilized, to change from red to yellow, in the same solution of NaOH, it is found that just after fertilization (2–5 minutes) the egg is much more permeable to NaOH, despite the fact that it is surrounded by a fertilization membrane. While my experiments were being performed I was unaware that Loeb had been studying the relative injurious or destructive action of alkali on the fertilized and unfertilized eggs and had found the former to be most quickly injured. My results with red-stained eggs show that the injurious action is actually due to the penetration of alkali. The same is true if we form the membrane artificially by treatment with acetic acid (in *Asterias*). In the only series of experiments performed, with *Toxopneustes* eggs, between ten and fifteen minutes after fertilization the eggs return to the same condition of permeability, with respect to alkali, as the unfertilized. There appears to be a second increase at the time of first cleavage.

Thus far I have found no dye which is harmless for eggs and at the same time changes in color in acids. The egg of *Hydractinia,* however, contains a natural green pigment which becomes red in HCl but not green again in alkali. The color change also takes place when the eggs are slowly heated.

If we place unfertilized *Hydractinia* eggs in 50 c.c. sea water + 3 c.c. *n*/10 HCl it takes half an hour for the green pigment to become red. If first treated with chloroform-saturated sea water, and then placed in the acid sea water the color change is almost instantaneous. Thus the normal eggs are relatively impermeable to HCl. Unfortunately carbonic acid is too weak to affect the color of the green pigment, and we can not test the permeability of fertilized and unfertilized eggs to CO_2. The end of the breeding season has made a comparison of the entrance of HCl into the fertilized and unfertilized eggs impossible.

A phenomenon that occurs, if the treatment of an egg with chloroform and many other membrane-forming substances be prolonged, is cytolysis. It is characterized by the swelling of the egg and the decomposition of the visible granules which appear to fuse to larger more liquid spheres, with a loss of their natural pigment or of their stain if first placed in a solution of neutral red. By the use of the centrifuge, which brings about such a distribution of the chemical constituents of the egg that we can readily see exactly what happens to each of them, it may

be shown that only the yolk and pigment granules break down. The oil is unaffected. The eggs are first centrifuged and then cytolyzed (with $CHCl_3$ or saponin) or first cytolyzed and then centrifuged. Swelling and break down of the granules take place simultaneously and suddenly. It is impossible to say which precedes and which follows. Many eggs contain granules which do not break down on cytolysis although the whole egg swells so that it would appear as if the connection of the granules in an egg with cytolysis were purely secondary and that chloroform or saponin does not combine with them and break them up. Clear fragments of eggs cytolyze as readily as granular fragments.

This supposition is further supported by the fact that the granules (excepting oil) of *Arbacia* eggs are broken up into *exactly the same products characteristic of cytolysis when the eggs are crushed in sea water.* There must be something in the egg in whose presence the granules are stable or something in the sea water in whose presence they are unstable, and the egg surface forms an impenetrable barrier for this substance. The latter alternative may be tested much more easily experimentally and it appears probable that the calcium salts of sea water are chiefly responsible for the breakdown of the yolk and pigment granules. If crushed in pure 0.6 *m* NaCl or KCl the granules retain their color and integrity. If cytolyzed in pure NaCl the granules remain intact, although they are changed in some way, for any dye or pigment they may contain passes out of them. The whole egg nevertheless swells. The cytolysis of the sea-urchin egg would be in all respects like that of the annelid were it not for the calcium of the sea water. The yolk granules of annelid eggs are stable in sea water.

The relation of calcium to cytolysis shows further that it is not present in the egg in the same condition as in the sea water and does not pass into the egg in that condition unless its surface has been destroyed by some cytolytic substance.

The conception of cytolysis to which I have been led is essentially that of Hamburger, Koeppe and other physiologists. It is certain that during cytolysis there is a progressive change from impermeability to complete permeability for most diffusible substances, for it is a change from a definite plasma membrane to no true surface whatsoever, if the eggs remain in the solution long enough. The apparent surface of cytolyzed eggs is merely the artificial fertilization membrane formed in the first stages of cytolysis. The permeability of the plasma membrane is increased to a certain extent and under these conditions substances pass out which form an albuminoid membrane. In the next stage the egg becomes permeable to the salts of sea water when swelling of the egg and disintegration of the granules takes place, and at the same time the egg surface loses its continuity.

The cause of the swelling is simply the substitution of a surface freely permeable to salts for one quite impermeable to them. In the normal egg the sum of the osmotic pressures of the substances within the egg just counterbalances that of the salts of sea water. This does not mean that the substances within the egg are the same as those without. The egg is not a mass of proteid saturated with sea water, but even its salt content is different. Suppose the membrane separating these two phases becomes permeable for the dissolved substances of one phase but not for those of the other. The result is the same as placing the cell in distilled water. It swells until its turgor pressure is balanced by the tension of its artificial membrane.

The slowness with which eggs swell when placed in distilled water, considering the large surface area, points to the view that even water encounters resistance in its exit from and entrance into the egg. In distilled water the egg slowly swells to a certain size, at which point it suddenly swells and a delicate membrane forms. I am inclined to believe that at this point the surface becomes freely permeable to the entrance of water and the whole egg swells (within the artificial

membrane which forms at the same time) until its internal pressure is compensated by the tension of its membrane.

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August 31, 1910

COMPARATIVE ANALYSES OF WATER FROM THE GREAT SALT LAKE

From about 1900 until 1904 fears were expressed that the Great Salt Lake was doomed to extinction, and that it would be a matter of only a few years until its site would become a salt desert. The recession of the shore line and sinking of the lake level continued until the autumn of 1903. Since that time there has been a rise in the level of the lake, and during the year just ending new fears have arisen—fears that large engineering works like the Lucin cut-off of the Southern Pacific and the roadbed of the Western Pacific railroad would have to be abandoned. A succession of years with abnormally high rainfall is responsible for the condition now existing.

TABLE I

Date of Collection		Specific Gravity	Total Solids Per Cent. by Weights	Grams Liter	Authority
	1850	1.170	22.282	260.69	L. D. Gale
Summer	1869	1.111	14.9934	166.57	O. D. Allen
August	1873	1.102	13.42	147.88	H. Bassett
December	1885	1.1225	16.7162	187.65	J. E. Talmage
February	1888	1.1261			J. E. Talmage
June	1889	1.148			J. E. Talmage
August	1889	1.1569	19.5576	226.263	J. E. Talmage
August	1892	1.156	20.51	238.12	E. Walker
September	1892	1.1679	21.47	250.75	J. E. Talmage
	1893		20.05		J. T. Kingsbury
December	1894	1.1538	21.16	244.144	J. E. Talmage
May	1895	1.1583	21.39	247.760	J. E. Talmage
June	1900	1.1576	20.90	241.98	H. N. McCoy and Thomas Hadley
July	1900	1.1711	22.89	268.09	H. W. Sheley
August	1900	1.1805	23.36	275.765	H. W. Sheley
October	1900	1.1860	24.03	285.020	H. W. Sheley
September	1901	1.1979	25.221	302.122	L. J. Seckles
October	1903	1.2206	27.72	338.36	William Blum
June	1904	1.1905	25.196	299.96	J. E. Talmage
November	1904	1.2120	26.71	323.71	William Blum
October	1907	1.1810	22.92	270.685	W. C. Ebaugh and Kenneth Williams
October	1909	1.1561	20.887	242.25	Wallace Macfarlane
February	1910	1.1331	17.681	200.32	Wallace Macfarlane

The above values are taken in part from "The Great Salt Lake," by J. E. Talmage, and all the analyses during recent years have been made in the laboratories of the University of Utah.

TABLE II

Sample Collected	Oct., 1903	Nov., 1904	Oct., 1907	Oct., 1909	Feb., 1910
Specific gravity	1.2206	1.2120	1.1810	1.1561	1.1331
Total solids	27.72 %	26.71 %	22.92 %	20.88 %	17.68 %
Constituents					
Chlorine (Cl)	15.27 %	14.54 %	12.67 %	10.91 %	9.48 %
Sulphate (SO_4)	1.86	1.82	1.53	1.39	1.05
Magnesium (Mg)	0.155	0.43	0.45	0 447	0.391
Calcium (Ca)	0.045	0.055	0.04	0.080	0.055
Sodium (Na)	9.58	8.77	7.58	7.25	5.79
Potassium (K)	0.73	0.89	0.72	0.76	0.88

An inspection of the results of analyses of the lake water will be of interest. In Table I. are shown the specific gravity and total solids obtained by investigators at various times during the last forty or more years, and in Table II. more complete results of the latest analyses are recorded. In this connection, it should be remembered that the annual variation of the lake water shows a minimum of total solids in the spring, following the winter and spring precipitation, and a maximum in the autumn.

W. C. Ebaugh
Wallace Macfarlane
University of Utah

A RARE FISH FROM THE NEW JERSEY COAST

A specimen of *Polyprion americanus* (Bloch and Schneider) was captured with hook and line by Captain Harry Maddox, eight miles off Asbury Park, N. J., on August 21, 1910. This species, known as the wreck-fish or stone-bass is said to be not uncommon in European waters, where it reaches a large size—five to six feet in length. Only a single specimen has been recorded heretofore on the American side of the Atlantic, taken by the U. S. Fish Commission in the Gulf Stream off the Grand Banks.

The specimen taken by Captain Maddox is therefore not only new to the New Jersey list, but is also the first to be recorded near the coast of the United States. It measured a trifle over ten inches and weighed thirteen ounces.

It was sent to the New York Aquarium for identification and has been turned over to the collection of the American Museum of Natural History.

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The New York Aquarium